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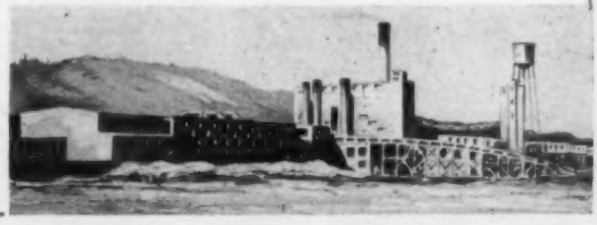

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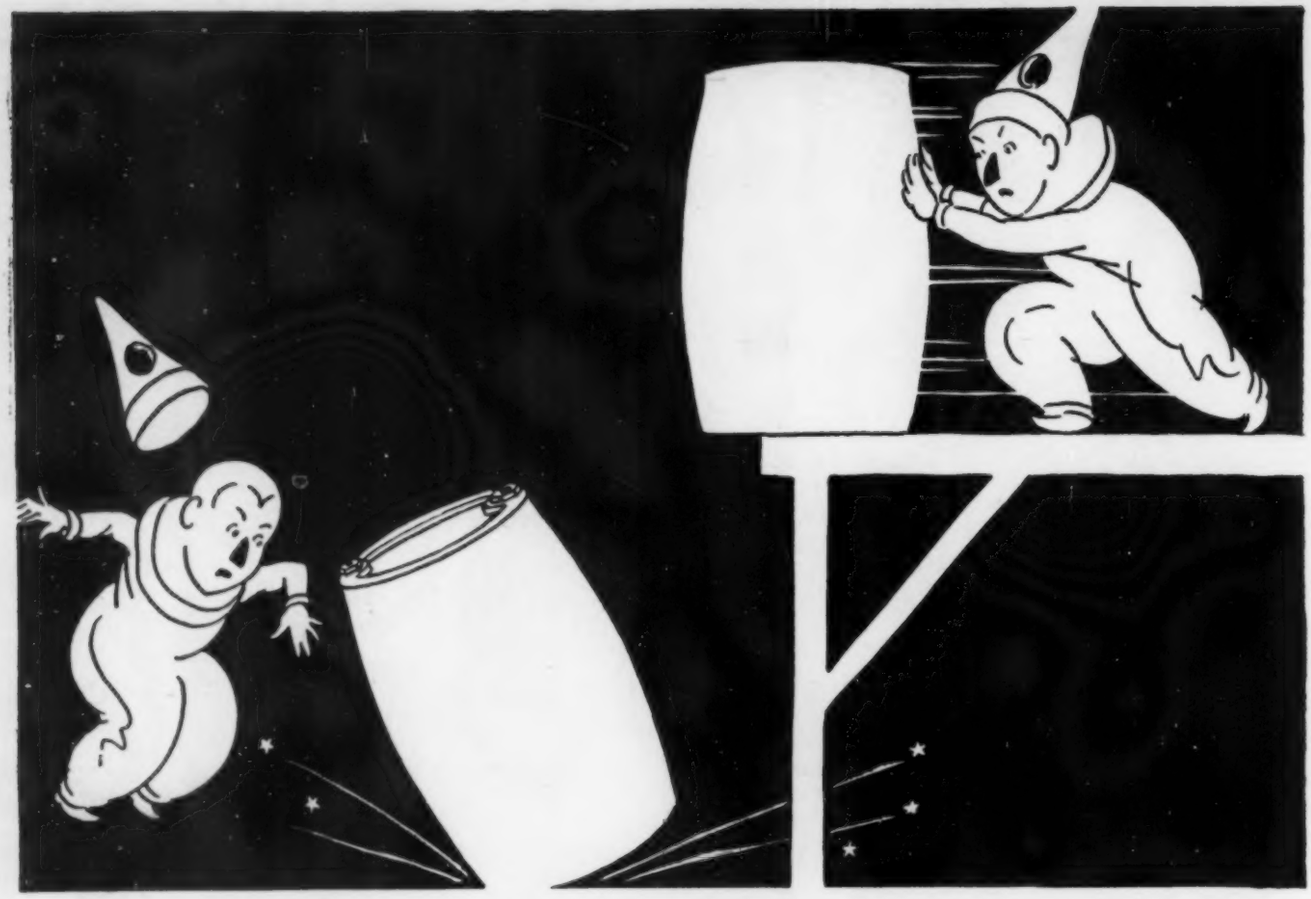

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CHEMICAL & METALLURGICAL ENGINEERING

VOLUME 37 NUMBER 8

A McGRAW-HILL PUBLICATION—ESTABLISHED 1902

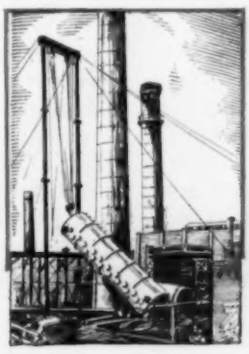
S. D. KIRKPATRICK, *Editor*

August, 1930

Five Factors in the Fight For Better Business

WHEN ASKED by *Advertising and Selling* to supply the dynamite that might break loose the present business jam, Stuart Chase prescribed five major blasting operations, viz.: (1) Raise wages to stimulate purchasing power; (2) check unemployment by maintaining wages but reducing hours; (3) spend heavily for extensions and improvements; (4) build up inventories in expectation of future sales; (5) reduce retail prices. Even in the chemical industries there is scarcely enough courage to go all the way with Mr. Chase. Proposals 3 and 4 are particularly pertinent, but as a substitute for the others, we would like to add: (1) Promote scientific research on the specialized economic as well as engineering problems that underlie the present situation; (2) maintain and develop adequate technical personnel; (3) go after business with aggressive advertising and selling methods.

RESEARCH, personnel, and advertising are the three vulnerable spots that come first to the mind of the budget trimmer when actuated by the great urge for economy. Surely, he thinks, no immediate disaster can result from a little judicious slicing here. Yet this temporary relief is likely to be dearly paid for out of future profits. Research is needed today, as never before, in guiding business through the shoals of readjustment and rehabilitation. Personnel building and training is a long and tedious process—which, if interrupted today, requires a new and costly start tomorrow. And, finally, there is advertising—least understood of all these factors, yet an industry's most valuable aid in time of stress.



NOW consider Mr. Chase's factors in relation to present-day conditions in the process industries: A few companies, notably Allied, du Pont, Carbide, and Westvaco, have gone ahead with major construction programs that to date have given new life blood to chemical engineering. It is a well-known fact, however, that many of the plans for new construction publicly announced last winter have so far failed to materialize. A number of goodly sized chemical plants are still "on paper." Research work was completed so long ago that the reports are turning yellow. Engineers are working over plans that have been finished and refinished periodically for months. Orders for equipment are hanging fire—in fact, everything is awaiting the word to go ahead. Yet in the face of this indecision there are many valid reasons for building *now*. Materials and equipment are cheaper than they have been for years. Labor, in both factory and construction, is at peak of efficiency. Most important of all, money is now generally available at favorable terms for financing modernization and expansion programs.

MR. CHASE, himself, places little faith in his suggestion about inventories. Perhaps he has too freshly in mind the 1920-21 fiasco, when business generally was caught with a lot of high-priced materials. Fortunately, hand-to-mouth buying saved us from that predicament this time. Mr. Chase may be surprised to learn, however, that more than one usually wary buyer in the chemical industry is quietly stocking up with important raw materials. For some months there has been a buyers' market for almost all the basic chemicals. Funds that were formerly employed in the call-loan market are now being used to better advantage in the commodity market. Cheap money, permitting the holding of larger raw material stocks by the manufacturers, is a good weapon against price advances, once business returns to normal keel. And this return will be effected just as soon as we are willing to take full advantage of all the favorable factors in the present business situation.

EDITORIALS

Dangerous Tampering With the Patent Law

SENATE BILL 4442, which passed the Senate on June 3 under the sponsorship of Senator C. C. Dill, proposed such a questionable change in our patent system that it was not surprising to find it subsequently withdrawn for reconsideration. It set up as a complete defense in any suit for patent infringement the proof that the holder of the patent was a party to a combination which, through cross-licensing or other agreement, was acting in unlawful restraint of trade. In other words, as punishment for violation of the anti-trust laws, a company might have its patents invalidated and taken over for use by an infringer without compensation. Representatives of the American Engineering Council and the National Association of Manufacturers and nearly all the leading authorities on patent law have vigorously protested against this attempt to place additional obstacles and uncertainties in the paths of the inventor and of the manufacturer who finances research and development.

Our patent system grants the patentee a limited period of monopoly during which he can develop his invention and profit from it. That right should not be taken from him merely because the firm owning the patent is in some way violating the laws relating to general business. Such violations are already punishable under existing statutes. Therefore the Dill proposal is not only unwise but unnecessary. If, as now seems likely, an attempt is made to revive it in the next session of Congress, the accredited patent committees of our trade associations and scientific and professional societies should renew their protests and reinforce their arguments with specific data showing the effect this legislation would have on the patent structure of chemical engineering industries.

Removing the Sting Of Unemployment

ONE of the commendable developments that has come out of the present depression is the attempt being made by many of our larger corporations to reduce to a minimum both the cause and effect of unemployment. Unfortunately, seasonal and general business recessions are going to recur, and it is only human nature that in times of prosperity the plant executive is either too busy to remember or forgets the necessity for providing adequate protective measures.

In one of the large electrical manufacturing concerns a trust fund, supported by the workers, and to an equal extent by the company, has been set up for payment to employees in times of need. Participating workers will pay into the fund 1 per cent of their earnings for a period of three years, but only as long as actual earnings are 50 per cent or more of the employee's average full-time pay. Equitable rules have been formulated for the numerous factories and departments of the company, which will tend to stabilize the employment situation and thus lessen the necessity for long lay-offs during periods of depression.

In another large organization the present depression is being used to double the efforts normally extended in the training of new men and the improvement of older personnel. It is here the company is investing for future profits. In discussing this policy a few days ago the personnel director remarked: "Last spring we combed the colleges and arranged to have several hundred young men come to work for us after graduation. Now that they are here, business is bad. We have no work for them. The short-sighted procedure would be to tell them so and pack them off to their homes. But even if business were better than in 1929, these men would not be worth their salt to us for perhaps a year. What are we doing with them? Why, going ahead and training them as if times were as merry as ever. Aside from the fact that letting them go would be the worst possible kind of advertising for us, we realize that these youngsters will be the men who will run our company in a few years. If we turned them out we would have lost a year in this regeneration process, and a year is worth a lot of money. Besides, it pays to let the men know that they are not the pawns of changing conditions but are a part of a permanent and growing business."

Fear of unemployment is present today in a great many plants and business organizations in the process industries. Any plan that will help to remove that fear is going to receive the enthusiastic support of the worker. Management has an opportunity now to accomplish something eminently practical in the field of human relations.

The British Version of "What is a Chemical Engineer?"

IN SUCH dog days as these when the heat, the drought, and the humidity all combine to reduce us to mere splotches of profane humanity, it is somewhat staggering to read the current examination papers of the (British) Institution of Chemical Engineers and discover with what high purpose the candidate for associate membership in that organization must be imbued. To be sure, summers in England are much more livable than in semi-tropical New York, but it is none the less the subject of our perspiring gratitude that examinations of such length (and difficulty) are not for us.

Hot weather, fortunately, did not conflict with the first section of the examination, a home paper for the answering of which the candidate had three months. This contained two groups of four questions, the prospective member picking one from each group. In the first there was a plant to design for anhydrous sulphur dioxide, nitric acid, or chlorobenzol; or a continuous distilling plant for acetone. The second offered possibilities for a critical survey of an industry, a comprehensive essay on temperature and pressure control, a power and heat analysis of a concentrating plant for NaOH, or the solution of a fairly complex condenser problem.

Then later, in July, the candidate presented himself for four more papers, three of three hours and a four-hour job of drafting. In the former a total of 12 questions out of 30 had to be answered, again giving considerable latitude of choice. Although none was easy,

most of them should have been answered satisfactorily by a chemical engineering senior in the United States. They ranged broadly from design, calculation, and fabrication to cost accounting and definition of business terms; from gas laws to diluted electrical engineering.

One wonders what leads the Institution to impose membership requirements of exactly this nature. Many people are but poorly convinced of the efficacy of examinations, even in school, in determining the suitability of a candidate from the viewpoint either of information or of knowledge. Although it would be interesting to have such a system tried out by one of the leading technical organizations in the United States to determine whether it could raise the professional standing of its membership list, it would seem that the method of the American Institute of Chemical Engineers, in depending upon past performance of the candidate and the opinion of his acquaintances in chemical engineering, is more in line with what it is desired to accomplish.

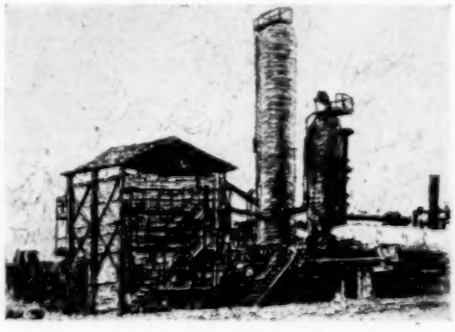
Reach for a Pencil Instead—

MILLER tires had their Paul Whitemans and James Montgomery Flaggs; Fleischmann's yeast its Professor Dr. Martin Mendelsohns; Palmolive had its society leaders and movie stars; Veedol its Rear Admiral Byrds; Luckies their Johnny Farrells and Babe Ruths; and chewing gum its Will Rogers.

For years these world-famous authorities have been revealing to the public their beauty secrets, how to avoid B.O. and how not to be one of the unlucky four out of every five. For years these informants have been recognized as the last word on matters from automobiles to chewing gum and yeast. But at last the chemical engineers have broken this monopoly and joined the ranks of the celebrities. Such respected scientists as Lincoln T. Work, of Columbia University, and W. H. Beisler, of the University of Florida, now tell us what oil to use in our Fords, and Jerome Alexander and Allen Rogers why we should use Colgate's tooth paste. At last the chemical engineer has reached a spot in the sun. Who will be the next to follow the worthy example of these men and assist in raising the standing of the profession to that of the movies and the stage?

Erasing the Stigma Of Costliness

LIKE an earlier age's concept of virtue, which, once compromised, could never again be redeemed by even the most exacting rectitude, so does a stigma seem to cling to inanimate products after critical judges have detected some offense. Of course, in the latter case an eventual return to favor can be accomplished, because it is less of a personal matter. The defect may be remedied and be later forgotten; but it may also become identified with the product and forever sadden its life: iron rusts, glass breaks, and wood rots. With platinum one always associates price; its long tradition of usefulness made it a necessary expedient in various technical applications, but meanwhile its cost impressed itself—and anyway, wasn't it used for jewelry? So the thought of resorting to platinum causes a pained nodding of the head, occupied within by vague phantoms of $150 the ounce. The stigma dies hard, not only among the users of the metal but also in various scientific cost calculations, despite the fact that over a long period the price has hung around $70 and in the past half year has decreased to approximately $40 an ounce.



That very few seem to be aware of the newer state of affairs is due largely to the long-inherited complacency of a parent which thought that its child's virtue needed no defense; and a salutary result has been the high birth rate of other materials designed to woo on the basis of specific attractions, especially cost. Some of them have thus gained rightful places of security in the industrial community; in any case they have been timely stimulants to their parents. But by erasing its traditional blemish, platinum now greatly extends the potential benefits of its well-established virtue, and those who have remained unconscious of the change, can certainly afford to know about it.

A Doctor of Pipe Phitting Receives the Legal Accolade

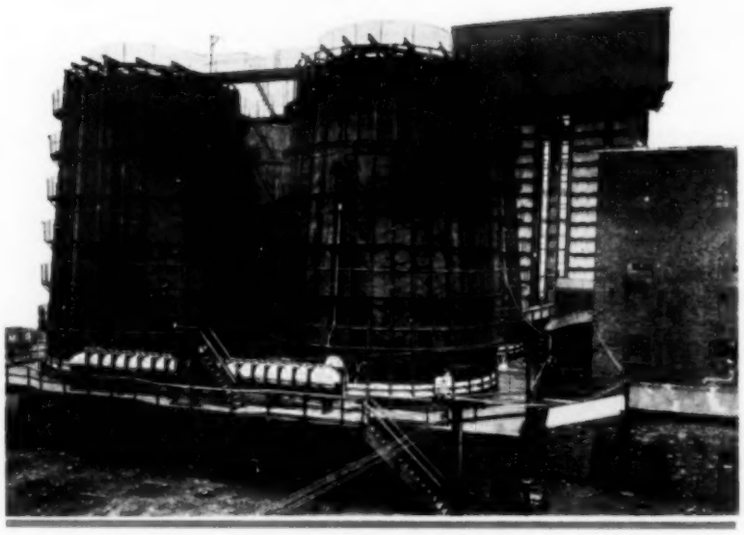
WHEN our good friend, Charles Raymond Downs, received the Grasselli Medal at the Chemists' Club in 1926, some wag opined that the letters after his name must have stood for Doctor of (Pipe) Phitting.

Biters are often bitten, which is the moral of this tale. Not only has the unstinted praise of an eminent judge been heaped on the head of the Doctor of Pipe Phitting but, what is more to the point, the court has upheld the validity (and has himself had his opinion in turn upheld by a court of appeals) of an important patent which came out of the Doctor's pipe-phitting proclivities. In his honor's own words, "the patentee in the instant suit made no startling discovery in chemistry, but he did produce a converter which was new, and which vastly increased the ability to manufacture phthalic anhydride. The facts established by the testimony are sufficient, it would seem, to overcome defendant's contention that the plaintiff's device was the result of ordinary chemical engineering skill. The patentee, Downs, was an experienced chemical engineer engaged in research work. He completed his converter only after numerous experiments and long pursuit of his basic ideas."

Perseverance is a most important qualification for a doctor of pipe phitting. When even as excellent a theoretical chemist as Dr. Downs has no scorn for cut-and-try methods in chemical engineering, it hardly behooves the rest of us to express amusement at an accomplishment so few possess to such a well-developed degree.

It might, in fact, be a good idea to award a degree of Doctor of Pipe Phitting to those post-graduate chemical engineers who show particular ingenuity, perseverance, and aptitude for plain, ordinary hard work.

EUROPE Replacing Old Chambers with Modern High-Capacity H_2SO_4 Systems



Mills-Packard Gutterless Water-Cooled Chambers of Chance & Hunt, Ltd., Wednesbury, England; Chamber Size: 35 Ft. Bottom and 28 Ft. Top Diameter; 48 Ft. High

ANDREW M. FAIRLIE
Consulting Chemical Engineer
Atlanta, Ga.

Returns from visiting plants in England, France, Belgium, and Germany

A RECENT JOURNEY to England, France, Belgium, and Germany provided me the opportunity to obtain, at first hand, reliable information about recent progress in the realm of chamber-process sulphuric-acid manufacture in the European countries mentioned. Some of the most prominent men in the sulphuric-acid industry in these countries were interviewed, many acid plants of recent design were inspected, and operating data from the books and report sheets of the various plants visited were obtained.

The important developments in chamber-plant design in Europe, during the past 15 years, have been the Mills-Packard chamber and the Gaillard turbo-disperser, together with the application of the latter to a specially designed chamber known as the Gaillard-Parrish chamber.

Mills-Packard Chambers

The original Mills-Packard chamber, described by the writer in 1921 (*Chem. & Met.*, **24**, 1921, 786), is well known in the United States as a successful and proved type of sulphuric-acid chamber. In shape it is a truncated cone about 50 ft. high, with lead curtains sloping inwardly 1 ft. for each 8 ft. of height (1:8), and encircled by a series of perforated lead gutters about 7 ft. apart, for the frequent redistribution of the cooling water applied externally at the chamber top. Installations of this original type of Mills-Packard chamber are to be seen in this country at Jacksonville, Fla.; Wilmington, N. C.; Houston, Texas; and East St. Louis, Ill. All of the American installations, however, have been built as adjuncts to towers, or to towers and rectangular chambers, previously existing, and therefore it has been impossible to obtain in this country data relating to a Mills-Packard plant, designed and erected completely as such.

Tessenderloo, Belgium—At Tessenderloo, Belgium, the Société Anonyme des Produits Chimiques operates two acid systems, each comprising four deSpirlet furnaces for roasting zinc blende, one Glover tower 13 ft. in diameter by 31 ft. high, two Gay-Lussac towers 13 ft. in diameter by 43 ft. high, and six Mills-Packard chambers of the original (guttered) type, and of a capacity of 17,650 cu. ft. each. Roasting 12 long tons of blende per furnace per day, this plant operated, during a period of three months, with an average atmospheric temperature of about 50 deg. F., at the rate of 3.8 cu. ft. of chamber space per pound sulphur burned per 24 hours. During this period the average chamber temperatures were reported to be: front chamber, 185 deg. F.; last chamber, 86 deg. F.

Since these chamber temperatures correspond to rectangular-chamber operation at the rate of about 12 to 14 cu. ft. of space per pound of sulphur per day, it is obvious to American manufacturers that these Belgian chambers could be operated at a much more intensive rate than that cited above. The figures cited show, however, that on the basis of cubic feet of chamber space, these Mills-Packard chambers were easily more than three times as efficient as old-style rectangular chambers; and it is fair to assume that if pushed to the limit of their capacity as rectangular chambers have been pushed in the United States, the Mills-Packard chambers would continue to exhibit a production capacity, on a cubic-foot basis, more than three times that of air-cooled rectangular chambers similarly pushed.

CHAMBERS at Tessenderloo are near enough in size to the No. 5 Mills-Packard chambers (18,750 cu.ft. capacity) to warrant the assumption that the latter would operate at virtually the same space-rate, under similar conditions. The ratio of square feet of cooled lead surface to cubic feet of space in the No. 5 chamber is as

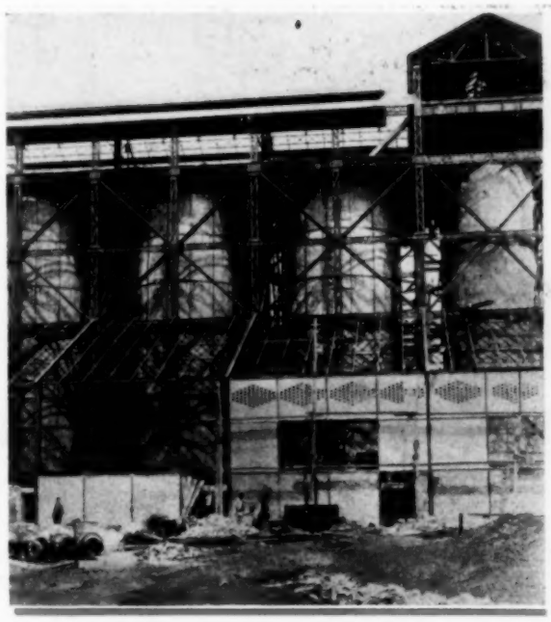
1:5.3. The above-cited space-rate figures may, then, be translated to the more rational basis of lead-surface-rate, whereby it is deduced that this size of Mills-Packard chamber operated during the period referred to at the rate of 0.718 sq.ft. per pound of sulphur per day.

In the average rectangular chamber, the ratio of square feet of cooled lead surface to cubic feet of space is approximately as 1:7. Such a chamber, operating at the above-cited chamber temperatures at the space-rate of about 13 cu. ft. per pound of sulphur per day would, then, operate at the equivalent surface rate of approximately 1.86 sq. ft. of lead surface per pound of sulphur per day. On this basis the Mills-Packard chamber is seen to be more than 2½ times as efficient as the air-cooled rectangular chamber.

In the United States, rectangular chambers under intensive operation have been operated at a surface rate as low as 1 sq. ft. per pound of sulphur per day, with chamber temperatures as high as 250 deg. F. in front and 160 deg. F. in the final chamber, and even higher. There is no reason to doubt that Mills-Packard chambers, similarly forced to equivalent temperatures, would still display an efficiency 2½ times that of the old-style chamber, or a surface rate of approximately 0.4 sq. ft. of cooled lead surface per pound of sulphur per day.

Cooling water used at Tessenderloo was reported to amount to 792 gal. per hour for each chamber, or 9,500 gal. per hour for the 12 chambers. It is reasonable to suppose that by increasing the flow of cooling water over the surface of the chambers, while operating at extreme intensity, the production capacity might be increased to even more than 250 per cent of that of the rectangular chamber, on a surface-rate basis, so that 2½ times as much acid might be made, per square foot of surface, without resorting to the high-depreciation temperatures necessary for such intensive work in air-cooled rectangular chambers. One chamberman and one helper on each of three shifts sufficed to operate the two acid systems at Tessenderloo.

Oldbury, England—The latest development of the Mills-Packard chambers is to be seen at the works of Imperial Chemical Industries, Ltd., Oldbury, England. Here a plant comprising six Mills-Packard chambers, two Glover towers each 14 ft. in diameter by 40 ft. high, and three Gay-Lussacs, each 13 ft. square by 43 ft. high, was completed in December, 1929. The six chambers,



Tower Chambers at Plant of Rio Tinto Company, Ltd., Huelva Works, Spain

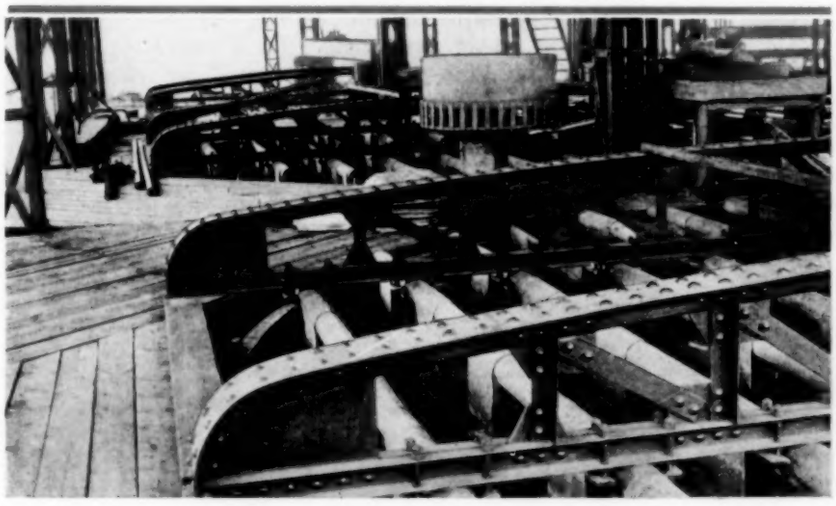
as originally designed, were 35 ft. in diameter at the bottom and 32 ft. at the top, and were 48 ft. high. The design, however, was modified in such a manner as to increase substantially the surface area. The additional surface provided is, like the sloping curtains of the chamber, cooled with water, externally applied. It should be noted that the sloping sides of these chambers are not far from vertical, the inward slope being only 1 ft. for each 32 ft. of height.

These chambers have no encircling troughs for the redistribution of the cooling water, in continuation of a policy that was first adopted in 1926. It has been found that the cooling water adequately envelops the chamber walls, steep as they are, without troughs, and the elimination of the latter saved a considerable part of the initial capital expense. The installation cost was further reduced by installing short horizontal gas connections alternately from bottom to bottom and from top to top of adjacent chambers (in place of the long downtake previously adopted), and by burning the lower edge of the curtain to the upstand of the chamber pan. This modified chamber, with dimensions as above noted, has a volume of 37,500 cu.ft., and a surface area of 8,700 sq.ft. There are, then, 4.32 cu.ft. of space for each square foot of surface.

During the first five months of this year, this plant was operating with one Glover, three of the chambers, and all of the Gay-Lussacs in service, on gas from spent oxide (50 per cent sulphur) burned in five-hearth Harris furnaces. Under these conditions the operating results listed in Table I were obtained.

Turning attention to the records for the first 27 days of May (the period of highest production, and likewise the warmest period), we note that the three chambers were operating at a rate of 3.44 cu.ft. (or 0.796 sq.ft.)

Top of Towers, Gaillard-Parrish Plant of Rio Tinto Company, Ltd., Huelva Works, Spain; Plant Capacity: 62 Tons of 60 Deg. Bé. Acid per Day



Gaillard Dispersers on Top of Gaillard-Parrish Chambers, Plant of La Companhia Industrial Portuguesa, Portugal

per pound of sulphur per day, with 4 per cent CO_2 in the burner gas, and with the gas leaving the last chamber at an average temperature of 91 deg. F. Since the niter consumption during this period was considerably less than 3 per cent, based on the sulphur burned, it is obvious that here, as at Tessenderloo, the chambers are capable of much more intensive operation than they have yet experienced, and could produce perhaps 50 per cent more acid than they have ever produced, if pushed up to the temperatures prevailing at rectangular chamber plants in America, operated at a rate of between 7 and 8 cu. ft. per pound of sulphur per day. The feasibility of controlling in some measure such high temperatures by increasing, at will, the flow of cooling water, extends still further the possible production capacity of these chambers—a reserve power which was pointed out above as applying to the Tessenderloo chambers.

Cooling water at Oldbury is recirculated, and cooled in a cooling pond. The quantity used on three chambers was 7,200 U. S. gal. per hour, or 2,400 gal. per hour per chamber. The water loss, including leakage, was 6 per cent of that used on the chambers. The temperature of the acid withdrawn from any chamber was found by long-continued tests to be consistently lower than the temperature of the cooling water leaving such chamber, and the average difference in temperature was about 4 deg. F. The effect on the life of the lead bottoms of substituting cool acid for hot acid in the chamber pan can be readily imagined.

The owners of the Oldbury plant are so well pleased with it that, although they have been operating the guttered type of Mills-Packard chamber for many years, they are erecting an exact duplicate of this new design in South Africa. Notwithstanding the saving of from 20 to 35 per cent in erection cost, as compared with rectangular chambers of equal capacity, the chief merit of the Mills-Packard chambers, these owners assert, is in the virtual elimination of maintenance expense, combined with the great reduction in depreciation.

Gutterless Mills-Packard chambers, with all straps parallel to the slope of the curtains but without the modification first developed at Oldbury, have been erected at Wednesbury, England; at Hrastnik, Czecho-Slovakia; and at Zagreb, in Jugoslavia.

Gaillard Turbo-Dispersers and Gaillard-Parrish Chambers

THE GAILLARD turbo-disperser, the invention of E. A. Gaillard, a Spanish engineer, is a centrifugal machine for the dispersion of pre-cooled acid in fine droplets into the atmosphere of an operating sulphuric acid chamber. The disperser is supported at the chamber top, outside, and only the revolving disk penetrates into the chamber. This machine has two distinct applications, both of which have been adequately described in *Chem. & Met.* by Percy Parrish (**36**, 1929, 68; **37**, 1930, 93). (1) It is applied to rectangular chambers, for the purpose of increasing their production capacity; (2) it is applied to typical Gaillard-Parrish chambers especially designed for acid dispersion.

Dispersers in Rectangular Chambers—One of the largest sulphuric-acid plants in Europe is located at Oberhausen, in the heart of the industrial district of Germany. This plant was found to consist of five separate acid systems, with rectangular chambers varying from 20 to 36 ft. in height. Without dispersers these chambers had been operated at a rate of 12 cu. ft. per pound of sulphur per day. The owners of this plant assert that after installing Gaillard dispersers in these chambers, the space rate was reduced to 6 cu. ft. per pound of sulphur per day—an increase in production capacity of exactly 100 per cent. When it is observed that this rate of production is obtained while operating on pyrite gas, and with chamber temperatures of 203 deg. F. in front and 113 deg. F. in the rear, and with a niter loss of less than 4 per cent, based on sulphur burned, the advantages of the Gaillard disperser and auxiliary equipment, as well as the possibilities for an even greater acid output, become manifest. This company has purchased at total of 33 dispersers.

A single small acid system at Hönningen, Germany, exhibited an even greater percentage of increase in production capacity, after installing dispersers. This plant, without dispersers, was producing at the rate of 13.4 cu. ft. per pound of sulphur per day. The addition of dispersers and auxiliary chamber-acid coolers brought the space rate down to the same figure as at Oberhausen.

One of the executives of the I. G. Farbenindustrie stated to me that the capacity of the company's rectangular chambers at Griesheim was doubled after installing dispersers and auxiliary acid coolers, and that with the aid of dispersers in chambers only 23 ft. high, the space rate has been reduced to between 6.7 and 7.5 cu. ft. per pound of sulphur per day.

Table I—Operating Data, Mills-Packard Plant of Imperial Chemical Industries at Oldbury, England

Month 1930	Average Gas Temperatures, Deg. F.						Avg. Daily Production Short Tons, 60 Deg. Bé.	Composition Glover Entrance Gas, Per Cent		Percentage Niter in Circulation on Sulphur Charged
	Leaving Glover	Chamber No. 1	Chamber No. 2	Chamber No. 3	Leaving Ch. No. 3	After Gay-Lussacs		SO_2	CO_2	
January	194	154	171	126	77	73	51.5	6.8	3.1	25.5
February	181	138	145	109	68	57	40.4	7.0	3.2	19.0
March	192	149	164	115	70	59	43.7	6.5	3.7	23.1
April	205	169	181	138	82	72	48.3	5.9	4.0	28.2
May (1-27)	216	176	192	149	91	82	61.7	5.7	4.0	28.0 (approx.)

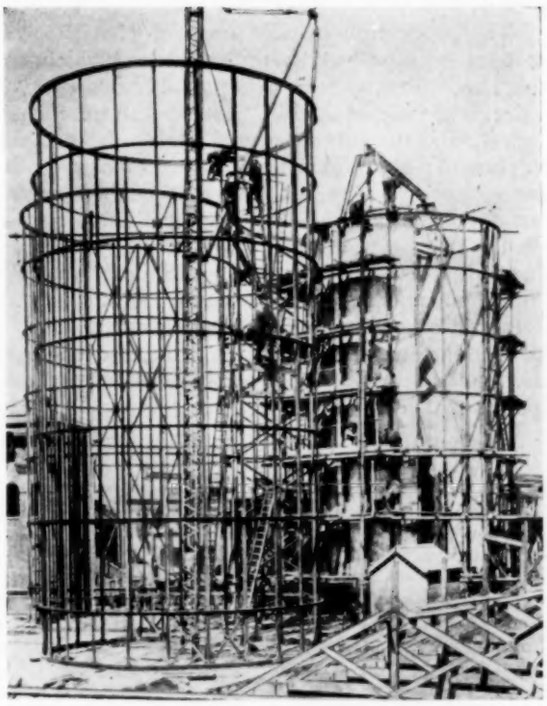
Table II—Gas Temperatures, Issoudun (France) Gaillard-Parrish Plant

	Dust Precipitator, Deg. F.	Chambers, Deg. F. No. 1	No. 2	No. 3
Gas Entering	1,022	194	167	131
Gas Leaving	842	167	131	95

Gaillard dispersers were first placed on the market in 1924. The dispersers at first were pulley-driven; but after two years of experience, it was found preferable to use direct-connected motors. Without counting the pulley-driven machines, a total of 271 dispersers with direct-connected motors had been supplied, up to June, 1930, to 71 different acid manufacturers, in the United States, France, Belgium, Spain, Italy, Germany, Denmark, Australia, etc. In all, more than 400 Gaillard dispersers have been purchased by sulphuric-acid manufacturers.

Gaillard-Parrish Chambers—Three typical Gaillard-Parrish plants have been erected in France by Union Espagnole de Fabriques d'Engrais et de Produits Chimiques. These are located at Issoudun, Voves, and Mondeville, with rated capacities, respectively, of 38, 38, and 57 tons of 60 deg. Bé. acid daily. Data relating to the Voves plant were given by Mr. Parrish in the second of the two articles above cited. There it was shown that during the month of March, 1929, Gaillard-Parrish chambers operated on pyrite at the rate of 3.71 cu. ft. of chamber space (0.71 sq. ft. of surface) per pound of sulphur burned out of pyrite per day. The data on which Mr. Parrish computed a series of heat balances for the paper cited included chamber temperatures at this Voves plant of 212 deg. F. entering the front chamber and 68 deg. F. leaving the rear chamber, and a sulphur consumption of 20,600 lb. per day for a total chamber volume of 73,500 cu. ft. This represents a space rate of 3.56 cu. ft. and a surface rate of 0.685 sq. ft. per pound of sulphur burned per day.

The Issoudun plant was inspected by me toward the end of April, 1930. This plant appeared to be virtually a duplicate of the Voves plant, and comprised a Glover tower 13 ft. in diameter by 39 ft. high; three Gaillard-Parrish chambers, each 23 ft. in diameter by 59 ft. high; and two Gay-Lussac towers, each 13 ft. in diameter by 49 ft. high. The total chamber space was 73,500 cu. ft., with 14,028 sq. ft. of lead surface. The ratio of cubic feet to square feet was as 5.23:1. There were four Maguin seven-hearth furnaces, 13 ft. 9 in. in diameter, with air-cooled shaft but with uncooled arms,



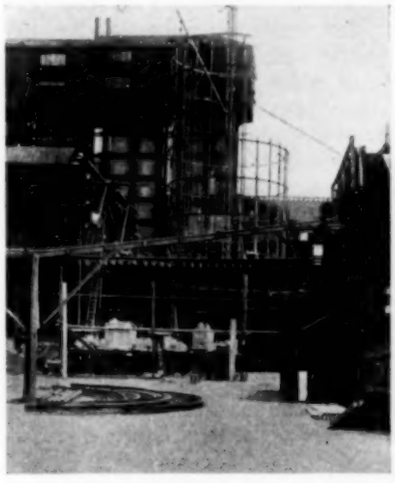
Chamber Steel Erected for Three Chambers and Lead Work in Progress Five Days After View at Right Below Was Photographed

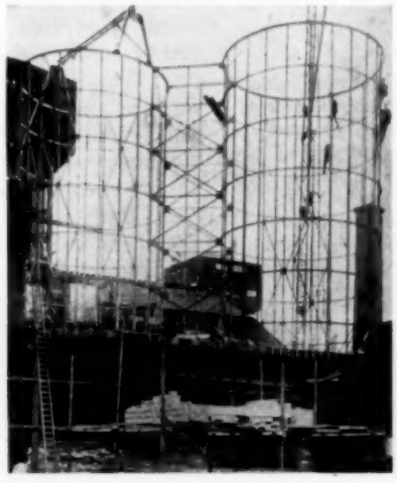
and an electrostatic dust precipitator of the tube type. The wires of special steel alloy, suspended in 8-in. diameter cast-iron tubes, were rapped at intervals of eight hours. Draft was produced by a Kestner fan located between the two Gay-Lussac towers, and the acid-pumping was done partly with Gaillard pumps and partly with Kestner pumps.

The ore burned was pyrite from Aljustrel (Portugal), containing 45 per cent sulphur, 0.2 per cent lead, and some arsenic. The sulphur content of the cinder was about 2 per cent.

Glover and Gay-Lussac towers were all up-drafted, but, curiously enough, the chambers were all down-drafted, and this conflow of dispersed acid and gas was adopted and preferred after having tried the counter-flow practice. Each of the three chambers was cooled on the top, but not on the curtains, with flowing water applied externally, and each was equipped with one Gaillard disperser located in the center of the top, where it operated with practically noiseless motion. Water for the chamber process was added to the supply acid for the dispersers at the tops of the chambers. The quantity of acid dispersed was 600 U.S. gal. per hour for each disperser. Three coolers were provided, for precooling the disperser acid supply. Two of these, of which the first received acid at 118 deg. F. from the first chamber, were connected in series, with the acid entering the second cooler at 88 deg. F. The third cooler received acid from the second chamber. The acid from the third chamber was not cooled. The plant was at that time burning 24.6 short tons of pyrite per

Gaillard-Parrish Plant Under Construction in London to Replace Rectangular Chambers; Views Taken a Few Days Apart of Erection of Chamber Steel





day, equivalent to 21,000 lb. of sulphur per day burned out. The production of acid was reported to be 39.5 short tons of 60 deg. Bé. acid per day, which corresponds almost exactly to 21,000 pounds of sulphur, with a 60 deg. acid yield of 3.75 lb. The space-rate, then, was 3.5 cu. ft., and the surface rate, 0.675 sq. ft., per pound of sulphur per day. That the ultimate capacity of these chambers had by no means been reached is at once apparent from inspection of the temperatures given in Table II.

Nitrate of soda, by the potting method, was in use for nitration, and the niter consumption was stated to be 2.42 per cent, based on sulphur burned.

As an indication of the progress being made in Europe by the Gaillard-Parrish chamber, the following lists of companies that have erected or have contracted for complete Gaillard-Parrish plants are appended.

COMPLETED GAILLARD-PARRISH PLANTS

Sociedad Concesionaria de Tabacos en el Riff; Porto-Pi Works at Majorca (Spain)—Daily production: 48 tons 60 deg. Bé. acid.

Sociedad Vasco-Andaluza de Abonos; Málaga Works (Spain)—Daily production: 38 tons of 60 deg. Bé. acid.

Fosfatos de Logrosan; Works at Logrosan and Villanueva (Spain)—Two plants, producing together 48 tons of 60 deg. Bé. acid per day.

Vieille Montagne, Baelen (Belgium)—One 40-ton plant.

Sociedad Iberica del Nitrogeno; Works at Felguera (Spain)—Daily production: 34 tons of 60 deg. Bé. acid.

Union Espagnole de Fabriques D'Engrais et de Produits Chimiques, 26 Rue de la Baume, Paris—

Issoudun Works:
Daily production, 38 tons of 60 deg. Bé. acid.

Voves Works:
Daily production, 38 tons of 60 deg. Bé. acid.

Mondeville Works:
Daily production, 57 tons of 60 deg. Bé. acid

The Rio Tinto Company, Ltd.; Huelva Works (Spain)—Daily production: 62 tons of 60 deg. Bé. acid.

Companhia Industrial Portuguesa, Lisbon (Portugal); Works at Povoa-de-Santa-Iria—Daily production: 29 tons of 60 deg. Bé. acid.

GAILLARD-PARRISH PLANTS UNDER CONSTRUCTION OR CONTRACTED FOR, JUNE, 1930

Société Anonyme des Produits Chimiques d'Auvelais (Belgium); Auvelais Works—Daily production: 45 tons of 60 deg. Bé. acid.

Société des Mines de Lens, Lens (Pas de Calais, France)—Three plants, each producing 62 tons of 60 deg. Bé. acid per day.

Tramvias Electricos de Grenade (Spain)—One plant for the daily production of 46 tons of 60 deg. Bé. acid.

Société Industrielle des Applications Chimiques, Brussels (Belgium); Grimberghen Works—Two plants to produce 62 tons of 60 deg. Bé. acid each per day.

Two units for Russia—Ural Mountains, name of owner not yet announced.

South Metropolitan Gas Company, East Greenwich, London—Replacement of unit embracing four rectangular chambers with four tower chambers, to produce 35 tons of 60 deg. acid per day. In this plant the capacity of the original rectangular chambers will be doubled, while only half of the original chamber-floor space will be occupied by the four Gaillard-Parrish chambers in course of erection.

L'Union Francaise de Fabriques d'Engrais at la Rochelle Pallice, France—One plant for the production of 62 tons of 60 deg. Bé. acid per day

Stress has been laid thus far chiefly on the superiority of these modern types of chamber from the standpoint of production capacity per square foot of lead surface, and the chambers have been shown to be about 2½ times as efficient, on this basis, as air-cooled, old-style chambers. The close observer of these liquid-cooled chambers is impressed by a number of other advantages which they possess.

With either of the modern types under discussion, the chamber building can be, and frequently is, omitted. Since in the case of the rectangular chambers the building is a huge and expensive affair, the saving in capital outlay resulting from its elimination is an item of great importance. Even where the owners elect to inclose chambers of the modern types, the building is much smaller and much less costly than a building inclosing rectangular chambers. The small chamber volume required, combined with the feature of having the largest dimension vertical, greatly reduces the ground space occupied per unit of production capacity. The compactness of the plant promotes ease of supervision and control to such an extent that the labor of "chamber walking" is all but eliminated. The tall chamber also connotes a small bottom area; and while the relatively cool pan-acid prolongs the life of the chamber bottom, when the bottom does eventually wear out, on account of its small size it is quickly and cheaply renewed. Fireproof materials are adopted in the chamber designs, in order to obtain the benefit of low insurance rates. Reduced maintenance and depreciation costs have been referred to above, and reduced interest charges are a natural consequence of the relatively small capital investment for these modern types of plant. Against these numerous advantages there is to be weighed the relatively small expense of pumping the water and acid necessary to produce the cooling effects.

RESULTS attained with Gaillard-Parrish and Mills-Packard chambers, operating separately, have been cited. But such results cannot be accepted as the last word in chamber-plant operation. It did not require a genius to combine external water-cooling with internal acid-dispersion, and the results of such a combination, at a plant now experimenting with it will, it is hoped, be announced before long. The possibilities apparently within reach by combining either the Mills-Packard plant or the Gaillard-Parrish plant with American intensive high-temperature chamber operation, await a demonstration. What space-rate and what surface-rate could be realized by means of a triple combination—external water-cooling plus internal acid-dispersion plus intensive American chamber practice—are at present subjects for conjecture.

In summary it may be stated that the foregoing data and observations indicate clearly that:

1. European manufacturers operate their Gaillard-Parrish and their Mills-Packard chambers as they previously operated their rectangular chambers, at a distinctly conservative capacity rate.

2. The capacity rate at which Europeans operate the modern types of chamber is comparable to a rate of not less than 12 cu. ft. of chamber space per pound of sulphur per day for air-cooled rectangular chambers having a volume-to-surface ratio of 7:1.

3. Both the Gaillard-Parrish and the Mills-Packard chambers are so far in advance of the air-cooled rectangular chamber, as regards production capacity per square foot of lead surface on per dollar of capital invested, that their advantage is patent.

4. The maximum production capacity of either of these modern types of chamber, or of a combination of them, has not yet been determined; but obviously the potential capacities are much greater than the rated capacities thus far published.

PHENOL—

A Survey of a Revived Industry

By JULES BEBIE

Chemical Consultant,
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IN VIEW of the remarkable recent increase in the production of phenol, the development of its domestic manufacturing methods, its uses, and an outline of the future trends have a renewed technologic interest. It will be recalled that two types of methods are being used for phenol manufacture: (1) Recovery from certain fractions in the distillation of coal tar, one of the byproducts from the manufacture either of coal gas or of coke in byproduct ovens. Phenol produced by this method is identified as "natural" phenol. (2) Chemical processing of benzene, which is also a byproduct of the coal-gas and byproduct-coke industry, to produce "synthetic" phenol.

Before 1914, the American production of phenol was exclusively from coal tar and amounted to about 1,000,000 lb. per year. Most of the domestic demand was supplied by import from Europe, chiefly from England. At the outbreak of the War, imports were cut off and the demands increased rapidly, on account of the requirements for the military explosives picric acid and ammonium picrate. As a result, an enormous synthetic-phenol industry was created with a peak production of over 100,000,000 lb. in 1918.

In 1918, the American government had a stock of 35,000,000 lb. of phenol. This was sold to consumers for about 10 cents per pound and was expected to last at least four years. In the meantime, the synthetic-phenol plants were mostly dismantled. Due to increased demand for phenol in the manufacture of synthetic phenolic resins, the war stock moved faster than was anticipated, and as a result, synthetic phenol was produced again in 1923 and one of the large resin manufacturers built his own phenol plant. In 1929 the total domestic production was again above 24,000,000 lb., over 80 per cent manufactured by synthetic methods. The year 1930 will show a very material decrease in the production of phenol, due to the slump in the automobile and radio industries, which are some of the main users of synthetic phenolic resins. The trends become evident from Tables I and II.

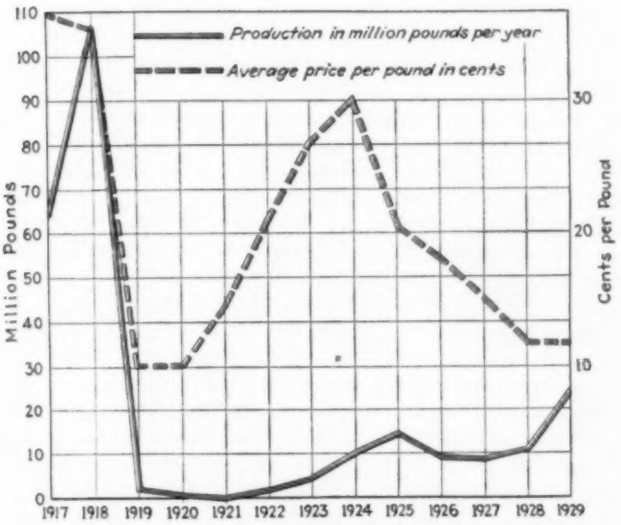

Table II—Production and Cost Curves of Phenol for the Period 1917-1929

Table I—Production, Price, and Imports of Phenol, 1917-1929

(U.S. Tariff Commission "Census of Dyes and of Other Synthetic Organic Chemicals")

Year	Total production in lb.	Natural phenol in lb.	Average price per lb.	Imports in lb.
1917	64,146,499	.....	$0.37	30,700
1918	106,794,277	.....	.35	148,300
1919	1,543,659	.....	.10	.....
1920	.....	.....	.....	.....
1921	.....	.....	.14	250
1922	1,285,278	.....	.21	349,500
1923	3,310,911	More than 1,650,000	.27	126,600
1924	10,521,944	.....	.30	176,100
1925	14,734,065	Less than 3,400,000	.21	256,126
1926	8,691,181	Less than 2,170,000	.18	218,437
1927	8,041,082	Less than 2,000,000	.15	500
1928	10,227,489	Less than 2,045,000	.12	1,653
1929	24,177,000	.....	....	432,266*

*For first six months of 1929.

PROTECTION of the American phenol industry by means of an adequate import duty is typical of how a new industry is supported by a tariff during the early years of its development, and how a flexible clause gradually reduces the duty while the industry is improving its process and reducing the cost of the product. Prior to the War, phenol importation was free of duty. By the Tariff Act of 1922, phenol was afforded a protection of 40 per cent ad valorem and 7 cents per pound. In fall 1927, the President proclaimed a decrease in the rate of duty on phenol to 3½ cents per pound and 20 per cent ad valorem following a cost-of-production investigation by the Tariff Commission. The same rate has been adopted for the new Tariff Act of 1930.

The decline in the average sales price for phenol from 37 cents per pound in 1917 to 12 cents per pound in 1928 is the best illustration of the remarkable progress which has been made in raising the efficiency of the domestic phenol manufacture. It also shows that an adequate tariff protection in the early stages of an industrial development does not need to stop the protected industry from making strenous efforts toward improvements of its processes. The flexible tariff clause and

keen domestic competition make progressiveness a necessity.

In spite of the fact that phenol from tar does not have a prominent share in our domestic production of phenol, this source of supply deserves serious consideration. It is quite possible that cheaper and better methods for recovery of tar acids might be developed which might change the picture considerably; hence it is here endeavored to emphasize the potentialities of natural phenol.

PRE-WAR American production of phenol was mostly derived from coal tar obtained from city gas houses, which contains a much larger proportion of phenol and cresol than tar from coke-oven plants. Meanwhile the water-gas process of making illuminating gas has to a considerable extent replaced the coal-gas process, and water-gas tar contains only traces of phenols. Any future extensive manufacture of phenol based on extraction of tar distillates would therefore have to resort to coke-oven tar as a source of raw material. Byproduct-coke operations may be called the backbone of the phenol industry, because they also furnish most of the benzene required for the synthetic methods for phenol production. The assured permanence and continued expansion of byproduct-coke-oven operations, therefore, is of greatest significance for the future.

Coke production in the United States in 1928 amounted to 52,689,025 tons, and 91.7 per cent of the total output was produced in byproduct ovens, whereas ten years before, in 1918, 54 per cent of the total coke output was still produced in beehive ovens. Accordingly, the production of benzene and coal tar has made steady progress, as will be evident from Table III.

Table III—Byproducts From Coke-Oven Operations, 1919 to 1929
(Figures From Bureau of Mines)

Year	Benzol Produced All Grades Million Gal.	Benzol Refined Million Gal.	Unit Value	Tar Million Gal.	Phenol Crude Gal.	Unit Value
1919	61.1	17.0	$0.26	289	.....	.....
1920	73.0	17.0	.26	361	.....	.....
1921	54.5	4.9	.24	253	.....	.....
1922	70.1	10.4	.28	328	.....	.....
1923	97.3	12.4	.25	441	.....	.....
1924	91.9	14.3	.21	442	.....	.....
1925	103.8	16.2	.22	481	.....	.....
1926	112.5	17.7	.23	529	.....	.....
1927	109.0	22.0*	.21	546	.....	.....
1928	124.4	21.4*	.20	632	57,794†	.....
1929	134.7	28.8*	.21	699	84,683†	$0.359

*Crude and refined. †Does not include production of Clairton plant.

Coke-oven tar constitutes now about 90 per cent of the total production of coal tar. Of the total production of 688,000,000 gal. in 1928, approximately 52 per cent was used for fuel and 48 per cent (336,000,000 gal.) was distilled and converted partly into complex mixtures such as motor fuels, solvents, dead or creosote oils and pitches, and partly into refined products such as benzene, toluene, naphthalene, phenol, and anthracene.

For the past ten years about half of the coal-tar production has been used for fuel, particularly in the operation of open-hearth furnaces. It is excellent for this purpose and, since byproduct-coke ovens usually are connected with steel plants, it is often considered more satisfactory to burn tar than to sell it to refiners and purchase substitute fuel. However, the trend is to get some values out of the tar before using it as fuel, and some coke plants are now subjecting the tar to a partial distillation, separating light and middle oils and using the residue for fuel purposes. This practice probably accounts for most of the considerable increase in the production of dead or creosote oils in recent years.

The production of these oils, used in increasing amounts for wood preservation, was 43,000,000 gal. in 1925, 76,000,000 in 1927, and 134,000,000 in 1928. The 1928 production was about 60 per cent of the total requirements, the remainder being supplied by import. Additional plants were placed in operation in 1929 and it is expected that this industry will further expand. Simultaneously developments are under way for increased production of tar acids. That a wide field is still open here for tar refiners is shown by the import figures for cresylic acid in Table IV.

Table IV—Imports of Cresylic Acid
(U. S. Tariff Commission "Census of Dyes and Other Synthetic Organic Chemicals," 1924–1928)

Year	Cresylic Acid, Free of Duty, Lb.
1924	2,327,528
1925	2,163,557
1926	5,702,740
1927	9,136,516
1928	10,687,109

As is shown in Table I, the production of phenol from tar had made but little progress up to 1928. The figures for 1929 are not yet available, but it is estimated that the production of natural phenol was about 3,000,000 lb., only about 13 per cent of total production. In addition a production for 1928 of 57,794 gal. of crude phenol is shown in Table III as production from coke-oven operations, and the U. S. Tariff Commission reports 200,899 gal. of carbolic or middle oil produced by firms not directly engaged in the operation of coke-oven plants and gas houses.

The crude phenol now produced from byproduct tar is directly applicable in the manufacture of certain types of synthetic resins and the tendencies are for further expansion in the production of this kind of crude phenol, particularly since the largest byproduct-coke-oven plant, the Clairton plant of the Carnegie Steel Company, is now equipped to carry out its own refining operations.

With a phenol content of byproduct tar estimated at 0.7 per cent, the annual production of 700,000,000 gal. tar represents a potential source of supply for almost 50,000,000 lb. of phenol. Today only a small percentage of this amount is recovered. Tar refining is an industry of great complexity, involving the production and the balancing of markets of a multitude of products, and it would be rather presumptuous to estimate what the increase in phenol production from this source might amount to within the next few years. However, in view of the complex nature of this business, it may be said in a general way that the expansion in the production of natural phenol is expected to be gradual rather than spectacular. In view of the steadily falling prices for phenol, which may not have reached bottom yet, it is possibly more attractive for the tar-refining plants to concentrate their efforts on the sale of mixed tar acids rather than on the production of pure phenol.

AMMONIA liquors from byproduct-coke plants are another potential source of large quantities of phenol. The tar-acid content of waste liquors from ammonia distillation in some cases created a serious nuisance, due to pollution of streams used for drinking water. This brought about recovery of phenol from ammonia liquors. In 1928 three plants reported a production of over 57,000 gal. of crude phenol from this source. It was

DR. JULES BEBIE, who makes this study of the phenol industry, was born in Zürich, Switzerland, and educated as chemical engineer in that city. When he came to this country in 1905, he joined the Monsanto Chemical Works at St. Louis and was its chemical director for many years before he retired in February, 1930.

recovered by extraction of the ammonia liquor with benzene, treatment of the benzene extract with caustic soda, and acidification of the resulting sodium phenolates.

In the description of such an extraction plant in Fairmont, W. Va. (H. E. Jones, *Chem. & Met.* p. 215, 1928), it is stated that 25,000 gal. crude phenol containing 54 per cent phenol was recovered from the operation of 60 Koppers ovens. If the crude ammonia liquor of all the 15,000 domestic byproduct ovens in existence would be treated the same way it would result in a production of 56,000,000 lb. crude, equivalent to 25,000,000 lb. pure phenol. The phenol content of the crude ammonia liquor at Fairmont averages 0.6 per cent, and it is stated that under these conditions the phenol recovery plant is self-supporting.

R. M. Crawford describes (*Ind. Eng. Chem.*, p. 168, 1927) an improved process which is self-contained, using sodium sulphide instead of caustic soda and using hydrogen sulphide for liberating the phenol. He states that with this system the phenol recovery can be operated at the average coke plant at a slight profit above operating charges.

Recently processes have been developed for recovery of phenol from ammonia liquor without the use of benzene, based simply on distillation methods. Such is the Koppers process which recovers phenol from partly distilled ammonia liquor in conjunction with ammonia distillation, giving a 95 per cent recovery of the phenol and requiring little additional labor. The operation of such a plant at the Hamilton Coke & Iron Company, Ohio, has recently been described (B. F. Hatch, *Ind. Eng. Chem.*, p. 431, 1929), and it is stated that the sodium phenolates recovered by this process have found a direct application, eliminating the need and expense for neutralization. The ratio of phenol to cresols in crude phenol from ammonia liquors is about 2:1.

In view of the successful operation of these various processes it is likely that they will be adopted by other coke-oven plants, particularly where possibility of stream pollution is a factor. However, a general application of this procedure for the sole purpose of tar-acid production is not anticipated, on account of the small margin of profit involved.

PRODUCTION of a smokeless household fuel by means of low-temperature carbonization of bituminous coal has been the goal of many commercial developments. No successful operations have been on record in this country so far, but this problem is of such far-reaching significance that it is bound to be solved in a satisfactory manner some day. Some of the low-temperature-carbonization processes give several times as much tar as high-temperature operations and the low-temperature tar is usually much richer in phenolic compounds. Any extensive development of low-temperature-carbonization processes might therefore entail a potential source of large quantities of phenol and other tar acids.

Early in 1928 the world's largest plant for low-temperature carbonization was put in operation in New Brunswick, N. J., but, unfortunately, it was not a commercial success. The total tar acid in the tar from this process runs about 25 per cent, the phenol in the tar about 1 per cent, and the cresols and xylenols about 10 per cent. While the percentage of phenol is not much higher than in regular coal tar, the content of other phenolic compounds is much higher, and it is possible that some of these products could be converted to phenol and cresols by means of cracking processes.

Other low-temperature-carbonization processes which operate at still lower temperature yield little of aromatic compounds in their primary tars and would therefore be of no significance for future phenol and cresol manufacture. At any rate, no matter what the type of a future successful low-temperature-carbonization process might be, it is evident that it will not be a factor in phenol production in the near future.

Taking everything into consideration in the field of coal and ammonia distillation, it may be concluded that the tendencies are for increased production of phenol, and particularly of crude phenol, but the development is not expected to be a rapid one and it is obvious that the bulk of the future phenol requirements, as far as can be seen now, will have to be supplied by the manufacturers of synthetic phenol.

SYNTHETIC phenol is now made by two methods: (1) By sulphonating benzene, neutralizing the resulting benzene sulphonic acid, and fusing the sodium benzene sulphonate with caustic soda; (2) by chlorinating benzene and heating the resulting chlorbenzene with caustic soda solution under high pressure.

The benzene sulphonic acid process supplied the bulk of the phenol production during the War and for the first few years when manufacturing was resumed in 1923. This process has been greatly improved and simplified by increasing the conversion in the sulphonation reaction, by elimination of the cumbersome liming process for removal of excess sulphonic acid, and by utilization of the sodium sulphite which is formed as a byproduct.

The chlorbenzol method has been successfully developed to a large-scale manufacturing process by the Dow Chemical Company, Midland, Mich., in one of the outstanding accomplishments of recent chemical research and engineering. The chlorbenzol process has been supplying increasing quantities of phenol, and in 1929 probably more than half of the total production was derived from this source. As a byproduct diphenyloxide is produced, the use of which as a heat transfer medium is now being developed.

As a result of keen competition and lower prices some of the phenol manufacturers using the benzene sulphonic acid process have discontinued operation. In 1929 Monsanto Chemical Works (including its plant in Nitro, W. Va.) was probably the only phenol producer operating by this process, maintaining this position by its favorable situation for manufacture of sulphuric acid and its continuous efforts for improvement of the process. The cost comparison between chlorbenzol and

benzene sulphonic acid processes is finally reduced to the cost of power and the relative cost of chlorine and sulphuric acid in two different localities. With efficient operations and favorable conditions for production of raw materials, the costs of raw materials are about the same in both methods of manufacture. It is doubtful that either process could sell profitably at prices much below the present level and it is anticipated that the two processes and the two manufacturers of synthetic phenol together will supply the bulk of the phenol requirements in the near future.

AN ATTEMPT is being made to simplify the high-pressure chlorbenzene caustic soda process by hydrolyzing chlorbenzene in the vapor phase with steam under ordinary pressure. A patent (Lloyd and Kennedy, U. S. 1,735,327) assigned to the Federal Phosphorus Company claims a method of making carbolic acid consisting in passing mixed vapors of steam and monochlorbenzol through a heated porous catalyst composed of silica gel or of a porous silica having a high order of catalytic activity. According to the specifications of the patent the vapors are passed through a furnace heated to approximately 700 deg. C. The products of the furnace are condensed and neutralized with caustic soda, the unaltered chlorbenzol is separated, and the sodium phenate converted to phenol with CO_2. Unless the use of caustic soda can be eliminated, this process would not seem to have any economic advantage over the Dow process.

Furthemore, a process operating at 700 deg. C. in presence of hydrochloric acid and steam offers quite a serious problem in corrosion and in finding suitable material for large-scale operations. Even at 700 deg. C. the reaction is far from being complete and requires several passes to get good conversion, which, of course, increases the cost for steam and power. Recent patents of the German I. G. (B. P. 288,308 and 308,220) are based on the same reaction, and it is claimed that the yield is increased by adding to the silica gel certain metals or metallic oxides such as copper, nickel, cobalt.

The ideal phenol process, of course, would be a high and direct conversion of benzene to phenol either by hydrolysis or by means of oxidation. Both of these reactions have been and still are under investigation (C. H. Bibb, U. S. 1,547,725; W. J. Hale, U. S. 1,595,299) and it is quite possible that such methods might be important factors in phenol production in the more distant future.

Phenol is used as a germicide and disinfectant and directly or as an intermediate in the manufacture of a great number of synthetic products such as medicinals, dyes, flavors, perfumes, photographic chemicals, resins, tanning materials, deterging and emulsifying agents, plasticizers, seed disinfectants, military explosives, and compounds for breaking oil-water emulsions. A recent new use of phenol which offers possibilities for new markets is in the oil industry for the refining of oils.

Table V—Production and Sales of Salicylic Acid and Salicylates in 1929

U. S. Tariff Commission's Preliminary Report of Census of Dyes and Other Organic Chemicals for 1929)

	Sales, Lb.	Production, Lb.
Aspirin	2,533,000	3,710,000
Sodium Salicylate	513,000	455,000
Salicylic Acid U.S.P.	1,577,000	4,219,000
Methyl Salicylate	1,510,000	1,572,000

Of the total production of 24,000,000 lb. of phenol in 1929, almost one-fourth was used in the manufacture of medicinals. The magnitude of this industry is evident from the figures shown in Table V.

The largest consumer of phenol, however, is the industry of synthetic phenolic resins, which are used in ever increasingly quantities in the production of various molded products. Large quantities are also used as insulating material and in the manufacture of varnishes and coatings. Some of the basic patents have expired and a number of new manufacturers have entered the field. The rapid increase in production in recent years is shown in Table VI.

Table VI—Production of Synthetic Phenolic Resins

(U. S. Tariff Commission: Census of Dyes)

Year	Production, Lb.	No. of Manufacturers
1927	13,452,230	7
1928	20,411,465	9
1929	31,471,000	*

The further continued expansion of synthetic phenolic resins will to a considerable extent shape the extension in the future requirements for phenol. That the use of synthetic resins will make steady progress is practically certain, but in view of the development and expansion of new types such as vinyl, phthalic-anhydride, and urea condensation products, the phenolic resins will have to share the field with some of the others.

However, with the possibility of still lower phenol prices, which would open up new fields for the application of synthetic phenolic resins (for instance, hardwood substitutes and binders for various cellulose products) and in view of the commanding position of this industry at the present time, it is more than likely that it will maintain this position for many years to come. In other words, a steady expansion of phenol requirements and production is to be expected.

MANUFACTURERS of synthetic phenol are prepared to meet any increased requirements by the addition of units to their plants, hence it is not expected that importation will ever be an important factor again in phenol supplies. It is also anticipated that production of tar acids will be a factor of increasing importance.

The manufacture of phenol furnishes an interesting example of the trend of modern industry. Production of bulk commodities like phenol will be more and more concentrated to few plants operating at high efficiency and with continuous assistance of research for the purpose of improving the process, reducing the cost of the product, and for laying the ground for future and still better processes.

Synthetic *vs.* Chilean Nitrate

An Editorial Interpretation of the Competitive Situation

Editor's Note—Reorganization of the Chilean nitrate industry has apparently been credited by many with great prospective advantages for the producers of this material. However, a careful study of this situation made by the editors of CHEM. & MET. has failed to reveal any very promising prospect of relief from the fundamental causes of difficulty in Chile. This conclusion was first reported in our editorial on page 401 of the July issue and is now elaborated here in considerable detail in order to help the reader form his own judgment as to the ultimate prospects for this once-supreme natural monopoly.

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RECENT developments have clearly demonstrated that the American synthetic ammonia industry is capable of indefinite expansion. Byproduct ammonia from coal will also continue to grow steadily, although somewhat more slowly than was expected, because of the increasing use of natural gas. Hence from both synthetic and byproduct sources, generous and growing supplies of nitrogen are available for American use. The costs of production in the synthetic plants are constantly being lowered and the conversion of ammonia nitrogen to the nitrate form is not only entirely feasible but a relatively inexpensive operation (probably costing not more than 1.5 to 2 cents per pound of N.).

Competent chemical engineers who are thoroughly familiar with the nitrogen situation in the United States have estimated that synthetic sodium nitrate can be made here at a total cost of $25 to $27.50 per ton, including capital charges, depreciation, and amortization. Marketing costs for this synthetic nitrate will certainly be no higher than for the imported natural nitrate. The supply can be expanded indefinitely as long as market prices are attractive. Furthermore, this expansion can take place at any strategic point near the fertilizer market, almost without exception, without increasing the cost as long as sufficiently large plant units are employed. Therefore, the synthetic product can be manufactured at points which reduce to a minimum the freight item in the prices which must be charged for the product to the fertilizer dealers or users. Under these circumstances, it is estimated that Chilean nitrate must reach a United States port at an ex-vessel cost of $30 per ton if it is to compete on a profitable basis with domestic nitrogen products.

It does not appear that imported synthetic products such as urea, ammonium sulphate-nitrate, or other like products made principally in Germany or England, will for some time to come affect, in a major way, the competitive relations between synthetic and natural nitrate. This fact is independent of any tariff considerations. It is true largely because there is no inherent reason why these ammonia derivatives should be made in Europe and brought to the United States on a large scale. As a matter of fact, the ammonia from which these products are made can actually be produced within the United States at substantially as low a cost as anywhere else in the world. Therefore, one of the greatest threats to Chilean nitrate in the American market in the near future is the large-scale introduction of new nitrogen compounds of greater efficacy and produced at substantially lower cost than sodium nitrate. Already such developments are well under way.

BYPRODUCT ammonium sulphate can be made to cost almost anything that the producer chooses, according to his system of bookkeeping. It is probably safe to say, however, that ammonium sulphate does not represent a waste-disposal problem until its market price approaches $20 to $25 per ton, depending upon local circumstances. Furthermore, ammonium sulphate has to be made by most companies that now manufacture byproduct coke. In most cases the capital involved in its production is already written off. In a large number of cases the ammonia must be recovered and disposed of whether ammonium sulphate, anhydrous ammonia, or ammonia liquor is the product shipped.

Under these circumstances, comparison between Chilean nitrate and American-produced nitrogen products must assume marketing of ammonium sulphate at any price that will move it promptly. The producers of byproduct sulphate will not contemplate the building up of large stocks. If such stocks are to be held, except seasonally, for fertilizer manufacture, they have to be held by the fertilizer mixer or manufacturer, not by the byproduct-oven operator. Hence, the real competition lies at the moment between synthetic nitrogen products and Chilean nitrate.

For several years past nitrate nitrogen has commanded a differential over ammonia nitrogen of from 25 to 35 per cent in price. For a limited number of cases there undoubtedly is some justification for a differential, but apparently in no case a justification for so great a percentage differential as this, judged agronomically. One must conclude, therefore, that the differential has been made up largely of commercial preferences based on long-time habits which it is not safe to assume will continue indefinitely. The greatest danger ahead of Chilean nitrate probably lies in the fact that sooner or later it is going to have to meet the price of ammonia nitrogen much more closely than at present. To do so would demand that it sacrifice at least two-thirds of its present differential over ammonia nitrogen.

What lies ahead for Chile? Under the new reorganization it would appear that three possible optimistic features lie ahead for the Chilean nitrate industry:

First. The Chilean government can, and probably as a last desperate measure will, forego part or all of the income on its stock in the new corporation. This would permit lower prices for nitrate with profit to the producers; but the Chilean government would then have to secure a corresponding income elsewhere to maintain its present rate of expenditure. This would not be easy,

for the nitrate tax now represents about one-fourth of the total government income.

Second. Some concessions may possibly be made to the Chilean group by the international agreement with European industry. This might maintain tonnage outlets on a sufficiently high basis in Europe to favor the industry to a greater degree than now seems likely. Such a change would not have any important bearing upon the competitive situation within the United States, except as it might enable the nitrate producer to quote lower prices in this country than elsewhere without over-all world losses that would be intolerable. Such a combination might, indeed, intensify competition in the United States, presumably by further lowering average prices for all nitrogen products. It would not represent a permanent solution of the Chilean problem; it is at best merely a palliative.

Third. Reduced average cost of producing nitrate in Chile is certain to result from the expansion of operations by the Guggenheim process. Such improved processes cannot, however, be expected indefinitely to lower the cost of delivered nitrate at Eastern seaboard ports of the United States. Too large a proportion of the total cost is represented by handling, ocean freight, and other charges that are not affected by plant economies. Furthermore, savings in operating expense under the new process are offset, to a considerable extent, by higher capital charges on the more costly plants. In fact, the carrying charges on the capital invested in the Chilean industry today constitute one of the most serious elements in the cost of Chilean nitrate. Unless the reorganization can effect drastic economies in this regard, the natural nitrate must carry a heavy handicap in its competition with the synthetic product.

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The New Chilean Nitrate Law

Essential Provisions Under Which the Industry Is to Be Reorganized as a Semi-Government Corporation

Editor's Note—Most, if not all, of the preliminary accounts of the new Chilean law which have been published in England and the United States have been in error in regard to certain of the important provisions of this measure. Chem. & Met. has been privileged to receive a translation of the law as it appeared in the Official Daily of the Republic of Chile and has prepared these abstracts of the more important provisions.

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Organization and Purposes — The President of the Republic is hereby authorized to participate, in representation of the Treasury, in the formation of a corporation which shall be called: "Chile Nitrate Company" (Compañia de Salitre de Chile), whose organization and purposes shall be: . . .

1. To promote the general interests of the nitrate industry and trade and its byproducts.

2. To obtain, by means of a central organization, the improvement of the nitrate industry and trade and the use of its byproducts, and to promote scientific and technical investigations as well as the establishment of experimental plants and schools looking toward that end.

3. To conduct the propaganda, distribution, and sale of nitrate and its byproducts.

4. To make provision for the transportation and movement of all products related to the nitrate industry, as well as equipment and merchandise.

5. To centralize and nationalize the acquisition of the equipment and merchandise to which the foregoing subdivision refers; and

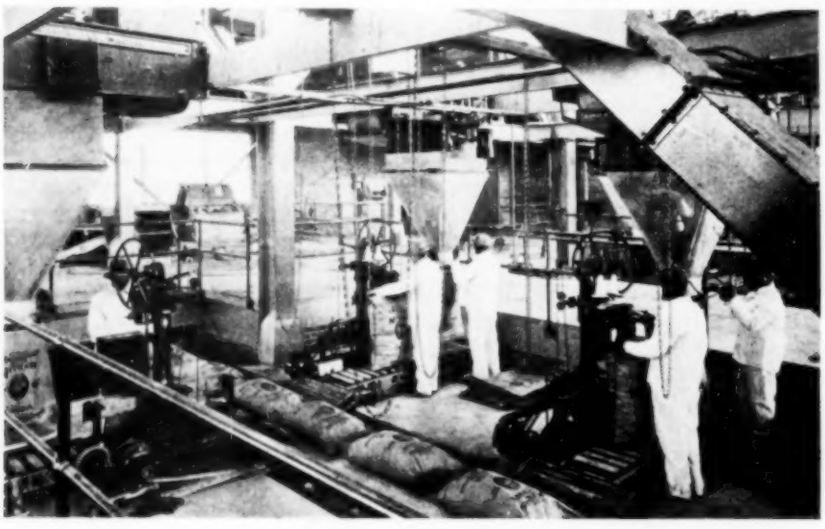
6. To examine, acquire and exploit nitrate lands; to acquire and exploit nitrate reduction plants; to sell the products produced and to enter into all kinds of contracts for the production, exploitation, sale, consignment, propaganda, transportation, and shipment of nitrate, its byproducts and accessories and, in general, everything related directly to the nitrate industry and trade and the fulfillment of the other purposes established by the present law. . . .

Capital and Shares—The capital of the company shall not exceed 3,000,000,000 pesos* legal currency, divided into shares of the value of 100 pesos each. . . . There shall be two series of shares: A and B.

The shares of Series A shall correspond to a total of 1,500,000,000 pesos and shall belong to the Treasury. These shares shall be considered fully paid upon formation of the company. . . . The shares of Series B shall be common or preferred and shall correspond to a total that shall not exceed 1,500,000,000 pesos; they shall be issued as the needs of the company may require and may only be paid for: (a) With the value of the properties conveyed by nitrate corporations or enterprises, whose assets and liabilities are assumed by the company; (b) With the value of shares of nitrate corporations acquired by the company; and (c) With cash funds.

The deeds of transfer of the assets referred to in letter (a) must neces-

Bagging Synthetic Nitrate of Soda in a Plant at Hopewell, Va.



*The law specifically defines the peso as the equivalent of 183,057 millionths gram of pure gold. Par value in U. S. currency is 12.165 cents. On Aug. 12 the Chilean peso was quoted in New York at 12.10 cents for checks and 12.15 cents for cables.

sarily include and specify, in addition to the properties which compose said assets, each one of the processes and patents of invention in use by the companies or owned by them and which must form part of the properties transferred.

The preferred shares shall not exceed 500,000,000 pesos. The holders of preferred shares of Series B shall have the right to be paid, preferentially, from the corporate profits, a sum equivalent to 7 per cent interest per year on their par value. If the profits of a corporate year should not be sufficient to pay these amounts in whole or in part, they shall be paid, preferentially, from the profits of the following corporate years.

The preferred shares of Series B shall have no other participation in the profits of the company than those indicated in the two preceding paragraphs, and their owners shall have right to vote only at special meetings. . . . Each one of the shares of Series A, and each one of the common shares of Series B, shall have equal participation in the corporate profits and losses. . . .

Nitrate Deposits—The Treasury shall grant to the company the exploitation of the nitrate deposits that form the fiscal reserve, and shall deliver them as the company needs and makes demand therefor. Such delivery shall be made in accordance with the existing official cubications or cubications made hereafter. The deposits shall be considered exploitable down to the lowest grade of nitrate earth which can be exploited commercially by the most modern method existing at the time of delivery thereof.

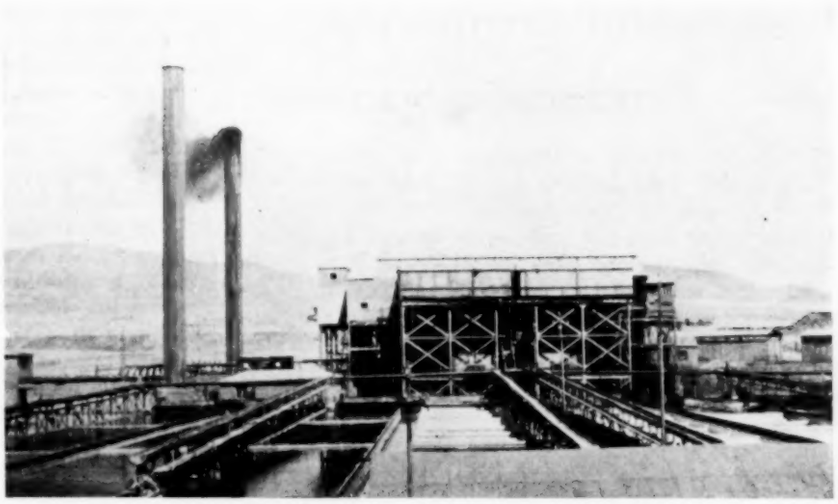
During the first ten years of corporate operations and as regards the delivery of deposits intended to be exploited in reduction plants using the Shanks system, only the grades of nitrate lands commercially exploitable by the said system may be taken as the basis for the cubication thereof.

If the nitrate contained in the deposits delivered to the company for exploitation should exceed 150,000,000 tons, calculated as above indicated, the excess may be bought from the Treasury by the company, or by the nitrate enterprises or corporations which shall have agreed to the prescribed rules, in proportion to their capital and to their respective production capacities. . . .

Administration—The company shall be administered by a directorate composed of twelve members, of whom four shall represent shares of Series A; seven shall be elected by the stockholders holding common shares of Series B; and one by the stockholders holding preferred shares of the same series.

The administration shall belong exclusively to the directorate, with the fullest powers to execute all acts and enter into the contracts comprised within the purposes of the company, set out in Article 4 of the present law, or which may be necessary for the fulfillment of its purposes.

The directorate may also contract debts, through the placing of loans for any length of time, or the issuance of bonds or debentures, in national or foreign currency, with or without guaranty of all or part of its properties; guarantee in the form and on the conditions that may be stipulated the dividends and obligations of nitrate companies, enterprises or corporations incorporated into this company or controlled by it; and grant to them loans or advances. . . .



One of the More Modern Shanks Process Plants in Chile

The representatives of shares of Series A may oppose, jointly or severally, in name of the President of the Republic, any resolution of a directorate relating to matters which they consider of national transcendency. In such case the said resolutions shall have no force until such opposition is withdrawn.

Without the favorable vote of said representatives, the resolutions referred to in the last paragraph of the preceding column may not be adopted, nor may the sale prices of nitrate be fixed nor may the annual production of the company be fixed, at an amount less than the average of the total sale of nitrate during the three nitrate years preceding the year of the resolution, deduction being made of the average sale of nitrate during such years of plants not incorporated in or connected with the company.

There shall be no recourse whatever against the oppositions made by the representatives of shares of Series A. .

Taxation—The nitrate and iodine produced by the company shall be exempt from the payment of the export duties established in laws number 980 of Dec. 30, 1897, and number 4113 of Jan. 25, 1927.

The company shall be subject to the payment of all other taxes, imposts, and duties now established or which may hereafter be established, with the exceptions and modifications indicated in the laws.

The nitrate lands which the state grants to the company for the exploitation of their deposits shall be exempt from payment of the land tax during such time as they remain unexploited.

The President of the Republic shall declare exempt from payment of the export duties . . . the nitrate enterprises or corporations, now existing or which may be hereafter constituted, which sell their production through the Chile Nitrate Company, and which, in the judgment of the President of the Republic, subject themselves to a regimen tending to the general fulfillment of the purposes of this law. . . .

In such case, the said enterprises or corporations shall remain subject to the system of taxes established in this law; but they must pay to the Treasury for each metric quintal of nitrate which the Chile Nitrate Company sells for their account, an amount equal to the amount which the Treasury should receive in that same annual period of sales, as net profit per quintal of nitrate sold by the Chile Nitrate Company. . . .

Transitory Provisions—During the calendar years 1930, 1931, 1932, and 1933, the Chile Nitrate Company shall pay to the Treasury, in each case and in cash, by matured quarters, and as dividends on Series A shares and as income tax, the minimum amounts indicated below—without prejudice to the sums in excess of said amounts which the company should pay under the same heads, and without prejudice, in the reverse case, to the enjoyment by the company of the benefit without charge whatsoever, of any difference between said amounts and the amounts which it should pay for the reasons stated:

In the year 1930, 186,000,000 pesos; in the year 1931, 180,000,000 pesos; in the year 1932, 160,000,000 pesos; and in the year 1933, 140,000,000 pesos.

The amounts which the Treasury has received in the respective years, as export duties on nitrate and iodine, paid in by other nitrate companies, enterprises or corporations, shall be considered as credits against such payments. . . .

This law shall go into effect from the date of its publication in the *Official Daily*.

And whereas, I have deemed it well to approve and sanction this law; therefore, let it be promulgated and put into effect as a law of the Republic.

Santigao, July twenty-one, one thousand nine hundred and thirty.—CARLOS IBAÑEZ C. President. RUDOLFO JARAMILLO, Minister of Finance.

Resourceful Engineering Produces a Specialty

GLASS WOOL, a substance of a few useful but modest applications, may be said to underlie a monopoly in this country. The only company manufacturing it on any scale is the firm of Friedrich & Dimmock, whose plant stands at Millville, N. J., in the midst of a voluminous glass-producing region. Glass wool is not the only specialty that issues from this small establishment, for the same two buildings house an energetic output of various precision goods of glass—spinerettes and glassware for rayon manufacture, to mention but one group.

Just after the War, all glass wool was still coming from Germany and became popularly known in such forms as the ink eraser. But industry had use for the material as battery plates, and Millville proceeded to develop a process for its manufacture. As is readily imaginable, the procedure was complicated and, moreover, seemed inadequate for supplying the potential demand. So, after some inevitable headaches and strains, a process was evolved which, because its creative throes were all disposed of right at the outset, now appears surprisingly simple. Within 3,000 sq.ft. of floor space it can produce some 500 lb. of the flimsy stuff each day.

Raw material choice for this process is guided by the service of the glass wool, which goes primarily into battery plates, to a lesser extent into filters and light diffusers, and recently into insulation for mechanical refrigerators. This permits the use of an ordinary flint glass, provided that it be free of lead and arsenic. This is then fabricated directly from standard ¾-in. rods about 2 ft. long.

The operation in itself is direct and simple. While in slow rotation, the glass rod is constantly heated and softened at its extremity by a small, regulated gas flame. When the glass tip has reached a proper initial softness, an operator touches it with a cold rod and, having accumulated a small gob, carries it about 15 ft. to the top of a large, rotating wheel and releases it there. The wheel takes charge from then on; the strand that has been pulled over this distance remains unbroken and is wound on the periphery of the wheel until the original feeding rod exists no more. In its home at Millville, this procedure knows no ramifications other than the mechanical demands made by commercial and flexible production, which required, however, most of the initial toil involved.

At present there are 12 batteries of glass rods and wheels installed, all, or any functioning part, being driven by a single electric motor, which acts by belt on a main shaft located above the strand-collecting wheels. These wheels may be disengaged as desired, together with the rod holder, the other unit of the battery.

The rod holders, also operating from the main shaft, are mounted on a special iron structure. At one end the 12 horizontal rods are inserted in the centers of individual interlocking gears arranged in a vertical zigzag fashion; these gears transmit the desirable slow rotation. At the other end the rods project through and rest on holes in a vertical panel, which gradually retreats to the stationary end as the rods are molten away. On an edge of this panel is fastened a narrow gas pipe, whose 12 small jets melt the protruding glass rods and follow them to their disappearance.

The noteworthy characteristic of this arrangement, shown in the illustration, is its automatic and inevitable synchronism. Once the operator has strung the 12 strands of each battery over their common wheel—a matter of a very few minutes—nothing further need be done until the rods have run out. That is to say, with a given motor speed, the gears will rotate the rods, the gas flame will melt the glass, and the winding wheel will draw the strands all in a fixed correlation that will give a definite strand size. Thus, if the motor is slowed down, the whole process must adjust itself to produce a heavier strand.

What may appear unusual, finally, is that no breakage of the thin glass strands occurs as they traverse the 15 ft. of space between units. This, of course, is the determining factor of the whole process, but it is interesting to add that the only precaution against running into the moving strands is the avoidance not of breakage but of facial cuts.

The glass wool is finally stripped from the collecting wheels and either shipped in hanks or fabricated into battery and insulating plates within the plant. The latter are made from uniform layers of wool that have been dipped in glue and dried in a convection chamber. They are shipped as porous plates with firm smooth sides.

To P. Friedrich, the originator of the numerous devices that are identified, so to say, with the products of this plant, the thanks of *Chem. & Met.* are due for the opportunity for a recent informative visit.

Treated Lumber Lasts Longer In the Process Industries

By HARRY E. TUFFT

Grasselli Chemical Company, Cleveland, Ohio

THROUGHOUT the ages wood has been the principal material for general construction. For centuries the use of wood, under conditions where decay or insect attack was inevitable, has caused heavy expense for replacement. Today through the application of chemical engineering to the treatment of wood, preservatives and methods have been developed whereby these destructive agents can be definitely overcome.

Chemical preservation of wood has been practiced in the United States for about 75 years. After many years of experimentation and study, zinc chloride and creosote were adopted as standard preservatives. Over 4,000,000,000 board feet of wood is now treated annually in this country, as compared to 900,000,000 board feet reported in 1909, the first year for which U. S. Forest Service statistics are available. Approximately 99½ per cent of treated wood has been impregnated with creosote, zinc chloride, or mixtures of these agents. Each of these two preservatives has come to be recognized as having well defined fields of use in the treatment of crossties, poles, posts, and structural materials.

Wood preserving is a large and highly specialized industry. There are 93 pressure plants in the United States, most of which are equipped to frame and treat timber and lumber to the user's specifications.

Standard specifications for wood-preserving processes and preservatives which have been developed by the American Wood Preservers' Association, are coming to be recognized and accepted in the United States, and also as important guides in other countries. The preservatives which the association recommends are zinc chloride and coal-tar creosote, but other materials that show commercial promise are investigated to determine their relative value for preserving wood. This article will be confined to the use of zinc chloride as a wood preservative in the chemical and allied industries.

The manufacture of zinc chloride is an industry of considerable importance. It is an industrial chemical and is manufactured on a large scale. The quantity of zinc chloride used annually in preserving wood approximates 23,500,000 lb., as compared with about 500,000 lb. of miscellaneous salts. While the greatest use is for wood preserving, large quantities are used also in the manufacture of commodities that have a wide distribution.

Zinc chloride is manufactured in three forms: solution, fused, and granular. The dry (fused and granular) salt dissolves in water to give a clear, colorless solution. Zinc chloride is not, as some suppose, a byproduct in the manufacture of chemicals but has long been a staple product of the chemical industry. Most of it that is used in the United States is produced from domestic crude materials. About 650,000 tons of zinc is produced annually in this country. Of this quantity, 590,000 tons is obtained from domestic ores, 10,000 tons from foreign ores, and 50,000 tons is salvaged zinc. Metallic zinc or spelter is the principal product from zinc ores, but an appreciable percentage of zinc is used for making zinc chloride. The crude metal, or spelter, is dissolved with hydrochloric acid, resulting in a dilute solution of zinc chloride. The solution is then subjected to several successive steps of purification and concentration.

Zinc-chloride Treated Lumber After Removal From Pressure-Treating Retort at a Commercial Wood-Processing Plant

In the manufacture of chemicals, including acids and various other products, wood is extensively used in the construction of storage tanks and other equipment. There are two causes of destruction of wood in chemical plants: mechanical deterioration due to the action of liquids and gases on the wood, and deterioration from fungus, causing rot. Frequently both of these agencies are at work, resulting in inevitable destruction of the wood. When conditions of service are so severe as to cause mechanical destruction of the wood in a limited period, it would not be economical to use treated wood. However, whenever fungus is the principal cause of failure, treated lumber can be used to good advantage for roofing, supports, and subflooring of buildings housing the operations.

There are many types of mill buildings in which the use of treated lumber has undoubted advantages. For many years paper mills and rayon plants have experienced difficulties in the construction of roofs. In addition to exposure to rot from outdoor influences, atmospheric conditions within the building are often conducive to growth of fungus. In machine rooms of paper mills, the use of equipment employed in mixing and dewatering pulp, rolling and drying the paper, results in warm, damp, atmospheres which come in contact with the underside of the roof and its supports. With even the best

equipment for removal of moisture and for maintaining uniform temperatures, condensation may occur at joints of beams and supports and in the tongue and groove or the splined connection between planks, or even on the upper side of the roof board beneath the insulation or finish roofing. As a result, many roofs of untreated lumber have developed rot.

While various types of roof construction have been tried with a view to eliminating condensation, the use of treated lumber for all members exposed to rot is recognized as good practice by leading architects and engineers in mill construction. In many instances the life of a roof of untreated lumber in paper mills and rayon mills does not exceed eight years, when repairs become necessary on account of rot attacking the structure. The use of zinc-chloride treated lumber under such conditions, will generally save one or more expensive replacements in a 25-year period of operation. The initial cost of using treated lumber usually will not add more than one-third to the cost. Cheaper grades of lumber often can be used when treated, thus partly offsetting the cost of treatment. Generally the treated lumber in the roof is covered with an insulating or waterproof composition. The amount of insulation used depends on the type of construction and climatic conditions.

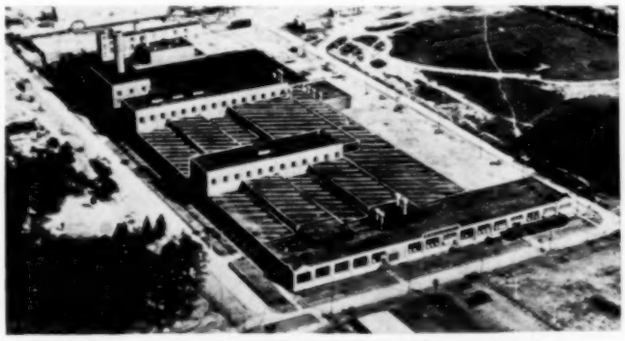
The Great Lakes Paper Company's mill at Fort William, Ontario, erected in 1928, has 851,000 board feet of zinc-chloride treated timber in the roofs of the ground-wood mill, sulphite mill, paper-machine room, screen room, and decker room. The roof is constructed of 3-in. zinc-chloride treated plank, on steel purlins. The treated plank is covered with a 2½-in. layer of insulating material, which is covered with 2-in. treated lumber, and completed with a four-ply tar and gravel top.

Several other paper and textile plants have a single layer of zinc-chloride treated roof timber, covered with different thicknesses of insulating materials. The River-

Roofs of the Pulp-Storage Tanks Were Constructed of Zinc-Chloride Treated Lumber, as Were the Roofs of Other Units of the Plant. The High Humidity in Plants of This Kind Accelerates Decay of Untreated Wood

side and Dan River Cotton Mills, Danville, Va., which recently replaced over 200,000 ft. of decayed untreated roofing with zinc chloride treated roofing, is typical of this latter type.

Wood floors are commonly regarded as having special advantages of resilience, quietness, warmth, and aiding comfort and health of factory workers. Preservative treatment imparts durability and permanence. Lumber treated with zinc chloride is being extensively used in laying subfloors of various types used in factory construction. In some installations, square-edge planks, treated with zinc chloride, are laid on a tar-concrete base. The planks are laid while the tar is still hot, to imbed them firmly, and are toe-nailed together. Then a surface floor of finish lumber, untreated, is laid transversely to the treated subfloor and nailed at close intervals to the subfloor. One large rayon plant in Virginia has installed



The Cross-Hatched Section of the Roof of This Rayon Plant Contains 475,000 Board Feet of Zinc-Chloride-Treated Lumber

250,000 board feet of zinc-chloride treated subfloors of this type.

In a number of rayon mills with zinc-chloride treated subfloors, treated wood sleepers are provided. The treated plank is securely nailed to the treated sleepers, and covered with a finish floor. In order to increase headroom, these are often imbedded in the tar or concrete base.

The new textile finishing and bleaching plant of the Fairforest Finishing Company at Spartanburg, S. C., includes a main building divided by a fire wall into a finishing room and a bleachery. That part of the building used for bleaching is 78 x 242 ft., and is two stories in height. In constructing the bleaching house, zinc-chloride treated lumber was employed, except for the first-floor beams, which are creosoted. The first floor is of zinc-chloride treated planking laid with open joints. After the treated lumber was installed, the interior was painted with acid-resistant paint.

The treated roofs and interior supports in factories are generally painted white for better lighting and appearance. Commercial installations, as well as paint tests of the Paint and Varnish Association, show that paint adheres to zinc-chloride treated wood without discoloration, checking, or flaking. The treated lumber, in addition to being paintable, is clean, odorless and corresponds closely in properties of expansion and contraction to untreated wood.

Zinc chloride reduces the inflammability of wood. Timber treated with ½ lb. of this chemical per cubic foot is slightly fire retardant, and timber treated with 1 lb. is appreciably retardant. Moisture when present in amounts exceeding 8 per cent, corresponding to timber kept in atmospheres of relative humidities of 50 per cent or more, markedly reduces the inflammability of zinc-chloride treated wood. So far, no fires have ever been reported in zinc-chloride treated installations. For treatment of mine timber, lumber, posts, and poles, a minimum of ¾ to 1 lb. of dry salt per cubic foot of wood is recommended. For complete flameproofing of dry wood, considerably larger quantities of zinc chloride would be required than are used in treating wood to prevent rot. Recent tests by the U. S. Forest Products Laboratory

indicate that this material is very similar to diammonium phosphate in retarding inflammability.

The U. S. Bureau of Entomology has for many years been making a study of the habits of termites, or white ants, which are reported to be prevalent in many of the Southern states and in tropical countries. For installations above ground, or those parts of the structure which are to be painted, also flooring, woodwork, and furniture, zinc-chloride treatment is recommended as a protection against termites and decay. For timber buried in the earth or in contact with the ground, creosote treatment is recommended.

Various other instances might be cited of the advantages and economies resulting from the use of treated wood in other industries related to the chemical industry. For example, the writer recently visited a plant for the chemical manufacture of ice, in which the roof is constructed of tongue-and-groove planks, 3 in. thick and 6 in. wide, which was treated with zinc chloride and covered with 6 in. of cork insulating material. Untreated lumber in a similar roof of this same plant, installed some years ago, is showing marked deterioration.

Industrial plants frequently have considerable fencing, which in some instances is painted for ornamental effect. Several state highway departments have adopted pressure treatment of highway posts or wood guard rail with zinc chloride.

Enough has been said to indicate the wide applicability of preserved lumber in numerous types of industrial construction. Lumber pressure-treated with zinc chloride and creosote is being stocked by retail lumber yards in Ohio, under a plan sponsored by the National Committee on Wood Utilization, and the wood-preserving and lumber industries.

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Applying Aluminum in Petroleum Refinery

By STANLEY GILL

Gulf Pipe Line Company, Houston, Texas

THE USE of aluminum and aluminum alloys in the petroleum refinery has shown a remarkable increase within recent years. A great impetus to this increase has been given by the development of numerous fields producing oils of high sulphur content. Hydrogen sulphide is a corrosive agent of great destructiveness, and aluminum is, generally speaking, quite resistant to its action. The possibility of obtaining in aluminum or its alloys materials of light weight, great strength and high resistance to corrosion makes them applicable under a wide variety of conditions.

The commercially available aluminum alloys cover a wide range of composition and of physical properties. They range from high-purity aluminum, which contains not less than 99.4 per cent aluminum, through a series of alloys containing greater or lesser proportions of various alloying elements. These alloys may, by appropriate heat-treatment, be given physical properties covering a wide range. Alloys possessing almost any desired combination of physical properties can be obtained in either cast or wrought form.

Differences in composition and in heat-treatment which are needed in order to fit the physical properties to the requirements of various applications have considerable influence upon the relative corrosion resistance of the alloys. Generally speaking, it cannot be stated just what alloy will possess the greatest corrosion resistance under any set of conditions, and usually it is necessary to test a series of alloys of proper physical characteristics in actual service before any conclusion can be reached on this point.

Much experience has shown that all of the commercial aluminum alloys possess a remarkable resistance to corrosion by gases or air containing high concentrations of hydrogen sulphide at temperatures below 250 deg. F. For application under such conditions, it may be stated quite positively that aluminum will give satisfactory service. This resistance has led to the successful application of aluminum in casing-head gasoline plants handling gases of high hydrogen sulphide content. Exact details of these installations are not available, but all information which can be obtained indicates that the aluminum equipment is giving excellent service. The most successful applications probably would be to heat exchangers, to gas lines handling corrosive gas, to absorbers, condensers, and the like.

The corrosion of large tanks in which high-sulphide crude oil or refined products are stored or handled causes great losses. The excellent corrosion resistance of aluminum to sulphide-bearing gases makes it particularly applicable for combating this corrosion. Due to the high cost, however, it is not feasible to use aluminum for the construction of a solid roof designed along the lines of the usual steel roof. Such an aluminum roof would cost four or five times as much as a steel roof.

Light-gage aluminum has proved its value as a sheathing over wooden decks of tanks handling highly corrosive crudes. On a tank of the Gulf Pipe Line Company, where this procedure was used, the 26-gage aluminum sheathing showed no corrosion after one year of service. Here the first cost of the aluminum was not at all prohibitive, since the cost of the metal sheathing represented only a small part of the cost of the tank-roof job. In addition to the corrosion reduction, the aluminum sheathing may be expected to effect an appreciable reduction of evaporation losses.

Aluminum alloys are widely used for numerous small items of tank equipment. The working parts of tank breathers and flame arrestors are cast of aluminum alloys. Floats and chains for automatic tank gages are being fabricated of aluminum. In all of these applications quite successful results are being obtained.

IN REFINERIES there exist certain conditions under which the use of solid aluminum tank decks will be justifiable. Extremely severe corrosion is experienced on run-down tanks when refining some oils of high sulphur content. Aluminum has demonstrated excellent corrosion resistance under these conditions. Where the corrosion is extremely severe, it is possible that the cost of solid aluminum decks will be justified by the savings.

It seems probable that the main applications of aluminum and aluminum alloys in refinery practice will be confined to small pieces of equipment which are not subjected to extremely high temperatures or pressures, but which are rather rapidly corroded.

Based on a paper delivered before the American Petroleum Institute, Chicago, Ill., Dec. 5, 1929.

Cheaper AMMONIA With Off-Peak Electric Power

By PAUL McMICHAEL

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THIS STUDY was made to ascertain the cost of ammonia synthesized from hydrogen produced in electrolytic cells using off-peak energy, if, when, and as available, from a modern base load, powdered-coal-fired, steam generating station.

In order to satisfy a peak demand that may be made during only a single hour in the entire year, electric companies must install and maintain generating equipment with capacity at least equal to the maximum requirement that may develop from any possible combination of circumstances or events that can be anticipated. As a consequence, almost all central stations have generating equipment ready to serve, the entire capacity of which will rarely be in service simultaneously as much as 80 hours during the year, or less than 1 per cent of the whole period.

With the continuing improvement in thermal conversion efficiency from fuel to electric energy that is being effected in generating equipment, and with the increasingly larger investment in plant necessary to obtain this result, fixed charges become the major fraction of the cost of generating electric energy in central stations. Unless fixed charges are diminished by wider spread over greater amounts of energy generated to supply firm demand, or operating conditions are so modified that improved thermal conversion can be attained by substantially continuous operation at rates of highest efficiency, the benefits resulting from the installation of better designed generating equipment and accessories are overtaken by the fixed charges on the increased cost of plant.

All fixed charges are universally assessed against the energy generated to supply firm demand. By continuing this practice, and also utilizing available equipment to generate energy if, when, and as it is *not* needed to satisfy firm demand, then considerable quantities of surplus electric energy, *free from fixed charges*, are made available for use or sale. The capacity-use factor of the station is thus increased, thereby decreasing the cost of generating all energy, both firm and surplus, by the operation of all station equipment at a rate closer to maximum efficiency.

Variations in load on a central station can be decreased only by filling in the valleys that appear on the daily, monthly, and yearly load duration curves. In order to do this, it is necessary to obtain users of off-peak (dump) energy that is only intermittently available. And this must be sold, if, when, and as it may be available, to such users at rates less than those necessary for normal-customer-demand (firm) energy, which rates, nevertheless, will be profitable, directly or indirectly, to the central station generating it.

In order to utilize off-peak energy, it must either be consumed as such when available on work of a kind that cannot carry the cost of firm energy, or else be utilized in such manner that it is converted into a form in which it can be stored for use during periods of peak demand. If it can be arranged so that not only is the available off-peak energy converted into a form in which it can be stored economically, but also that this conversion is in a direction for which energy must be expended in any event, then the most beneficial use of surplus off-peak energy will be attained.

Wherever there is use for hydrogen and oxygen either for consumption or sale as such, or as essential materials in industrial processes, especially chemical syntheses, there surplus off-peaks energy can be utilized in a highly beneficial manner in electrolytic cells to dissociate water into its component gases.

By building the electrolytic cell plant adjacent to the central station, transmission costs and losses are reduced to a minimum and the distribution system is kept clear for the transmission of firm energy, and by locating industrial plants that will consume the gases in the same vicinity, the hydrogen and oxygen produced can be stored in holders similar to those used for illuminating gas and pumped under relatively low pressures to wherever it is needed.

It has been shown (Paul McMichael, *Electrical World*, May 10, 1930) that the net increment cost of off-peak electric energy, free from fixed charges, is less than the cost of the fuel required for its generation, and that this cost varies from 1.319 mills per killowatt-hour with coal at $2.50 per ton to 2.609 mills with coal at $5. There are central stations in the Mississippi Basin that can derive substantial direct profit from the sale of surplus off-peak electric energy at a price of 1.5 mills per kilowatt-hour. Some of these stations are on navigable waters, so that liquid synthetic ammonia made near by could be transported cheaply to consumers on tank barges, and so located in respect to large manufacturing industries that the oxygen production could be absorbed by local users.

OFF-PEAK electric power, as the author shows in this analysis, offers interesting possibilities for the electrolytic production of hydrogen needed in making ammonia and other chemical products

Analysis of the operating records of one such plant disclosed that superposition on its annual duration load curve of the loads of electrolytic cell plants of 10,000, 20,000 and 30,000 kw. a.c. capacities increased the

Table I—Availability of Off-Peak Energy in Plant Analyzed

Cell Capacity, Kw., A.C.	Percentage of Time Cells Operate: Full Capacity	Part Capacity	Cells off	Total Annual Power Consumption of Cells, Kw.-Hr., A.C.
10,000	88.0	9.6	2.4	81,680,000
20,000	81.4	16.2	2.4	158,380,000
30,000	61.7	35.9	2.4	221,170,000

annual capacity-use factor from 56.7 per cent to 65.6, 73.9, and 80.7 per cent respectively, and that off-peak energy was available in the quantities and durations shown in Table I.

In Table II are given the capital requirements for an electrolytic cell plant of 10,000 kw. a.c. capacity and the cost per M. cu.ft. of the annual production of total gases therein when consuming an aggregate of 81,680,000 kw.-hr. a.c. of surplus off-peak energy at a cost of 1.66 mills per kilowatt-hour, a price at which it is procurable. The gas cost of 32.51 cents per M cu.ft. shown therein is decreased fractionally in plants of greater capacity because of the proportionately smaller gas-storage capacities required to insure continuous operation of gas-consuming industries of equivalent capacities with surplus energy only intermittently available. The cost of the total gases produced in cell plants of greater capacities is not decreased materially, because, as shown in Table I, the larger plants are operated at

Table II—Electrolytic Cell Plant Capacity Equivalent to 10,000 Kw., A.C.

	Capital Requirements
Cells	
15,000 amp. x 2.0 volts (30 kw. capacity) 300 cells (9,000 kw., d.c.) @ $20 per kw., installed	$180,000
Land, building and equipment: 40 per cent of cell cost	72,000
Converting equipment	
11,000 volt, a.c./660 volt, d.c., motor generator sets 9,000 kw., d.c. capacity @ $15/kw., installed	135,000
Land, building and equipment: 20 per cent of conversion equipment cost	27,000
Gas Storage and Handling Equipment	
One 2-million cu.ft. hydrogen holder, etc.	235,000
One 2-million cu.ft. oxygen holder, etc.	135,000
Gas mains	10,000
Total Plant Cost	$794,000
Operation and Maintenance	
Energy: 81,680,000 kw.-hr. A.C., @ 1.66 mills	$135,589
Cells	11,000
Converting equipment	7,000
Gas storage and handling equipment	5,606
Operation Cost	159,195
Fixed Charges: 15 per cent of capital requirement	119,100
Total Production Cost	278,295
Cost of hydrogen: two-thirds of total production cost	$185,530
Cost of oxygen: one-third of total production cost	92,765
Hydrogen made, M cu.ft.	578,839
Oxygen made, M cu.ft.	289,419
M cu.ft. total gases made: 73,512,000 kw., d.c. x 11.8111	868,258
Cost of gases per M cu.ft., cents	32.51

full capacity a lesser fraction of the time. In condensed form in Table III are given the capital requirements and operation costs of cell plants of 10,000, 20,000, and 30,000 kw. a.c. capacities.

Ammonia Synthesis

IN WHAT FOLLOWS, which deals with but one phase of the whole problem, it is assumed that the hydrogen produced in electrolytic cells with off-peak electric energy will be wholly consumed in ammonia synthesis, and that the oxygen produced simultaneously will be absorbed in the district at a price equal to the low pro rata production costs shown herein.

It is a well-recognized fact, not requiring exposition here, that very pure hydrogen has a utilization value in several chemical and metallurgical processes greater than in ammonia synthesis. Therefore, if it can be demonstrated to be economically practicable, under existing conditions, to consume electrolytic hydrogen in ammonia synthesis (which is a low-preference use), the possible utilization of off-peak electric energy in the chemical and metallurgical industries would seem to be indicated.

Table III—Summary of Capital Requirements and Operating Costs

	Cell Plant Capacities, Kw., A.C.— 10,000	20,000	30,000
Capital requirements	$794,000	$1,573,000	$2,097,000
Annual operation and maintenance	$159,195	$304,806	$425,627
Fixed charges @ 15 per cent	$119,100	$235,950	$314,550
Total production cost	$278,295	$540,756	$740,177
Energy used yearly, M kw.-hr., A.C.	81,680	158,380	221,170
Oxygen cost: one-third total production cost	$92,765	$180,252	$246,726
Hydrogen cost: two-thirds total production cost	$185,530	$360,504	$493,451
Oxygen made per year, M cu.ft.	289,419	561,193	783,678
Hydrogen made per year, M cu.ft.	578,839	1,122,385	1,567,357
Total gases made per year, M cu.ft.	868,258	1,683,578	2,351,035
Cost of gases per M cu.ft., cents	32.51	32.12	31.48

The estimated value of synthetic ammonia used in what follows is predicated upon existing conditions. Neither the trend of world prices for fixed nitrogen nor the possibility, by some declared imminent, of the production of fixed nitrogen at costs appreciably lower than are now attained, is germane to this study.

In a well-designed and efficiently operated electrolytic cell plant, the purity of the hydrogen produced normally will exceed 99.95 per cent. With hydrogen of such purity a utilization efficiency in excess of 92 per cent can be maintained in a properly managed synthetic ammonia plant. Furthermore, with pure electrolytic hydrogen available, instead of purified hydrogen contaminated by minute remaining traces of deleterious substances, a synthetic-ammonia plant can be operated more nearly continuously because of the less frequent

Table V—Capital Requirement for Synthetic Ammonia Plant

Annual Capacity (350 Days) of 660,000 M Cu.Ft. Hydrogen

Nitrogen Plant	
Linde air column units, capacity 30,000 cu.ft. nitrogen per hour Two units @ $32,500, f.o.b. Hamburg, Germany	$65,000
Freight, duty, motors and erection: 60 per cent of units cost	39,000
Purification equipment: 60 per cent of units cost	39,000
Building and foundation: 50 per cent of units cost	32,500
150,000-cu.ft. nitrogen holder and accessories	35,000
Ammonia Plant	
Modified Haber unit, capacity 25 tons ammonia per day One unit @ $200,000	$200,000
Erection: 15 per cent of unit cost	30,000
Building and foundation: 12.5 per cent of unit cost	25,000
Compression equipment, erected (3 compressors: 1 spare)	150,000
Building and foundation: 10 per cent of compression equipment cost	13,500
Miscellaneous	
Land and improvement of site	$50,000
Freight on machinery and equipment: 650 tons @ $15	9,750
Water supply, laboratory, shop and office	40,000
Engineering service	150,000
Total cost of plant	$878,750
Annual fixed charges @ 15 per cent	$131,813

Table IV—Daily and Yearly Productions of Synthetic Ammonia

Cell Plant Capacity Kw., A.C.	Hydrogen Made Yearly M Cu.Ft.†	Hydrogen Used— Daily* M Cu.Ft.†	Hourly M Cu.Ft.†	Daily* M Cu.Ft.‡	Hourly M Cu.Ft.‡	Nitrogen Used— Daily* M Cu.Ft.‡	Hourly M Cu.Ft.‡	Ammonia Made— Daily* Tons	Yearly Tons
10,000	578,839	1,654	68.909	1,541	64.205	514	21.402	21.89	7,661
20,000	1,122,385	3,207	133.617	2,988	124.496	996	41.499	42.44	14,855
30,000	1,567,357	4,478	186.590	4,172	173.854	1,391	57.951	59.27	20,745

*350 days per year.
†Measured at 20 deg. C. and 760 mm. atmospheric pressure.
‡Measured at 0 deg. C. and 760 mm. atmospheric pressure.

Table VI—Capital Requirement for Synthetic Ammonia Plant

Annual Capacity (350 Days) of 1,320,000 M Cu.Ft. Hydrogen

Nitrogen Plant	
Linde air column units, capacity 50,000 cu.ft. nitrogen per hour	
Two units @ $50,000, f.o.b. Hamburg, Germany	$100 000
Freight, duty, motors and erection: 60 per cent of units cost	60.000
Purification equipment: 60 per cent of units cost	60,000
Building and foundation: 50 per cent of units cost	50 000
250,000-cu.ft. nitrogen holder and accessories	49,500
Ammonia Plant	
Modified Haber units, capacity 25 tons ammonia per day	
Two units @ $200,000	$400,000
Erection: 15 per cent of units cost	60.000
Building and foundation: 12.5 per cent of units cost	50 000
Compression equipment, erected (3 compressors: 1 spare)	250,000
Building and foundation: 10 per cent of compression equipment cost	22,500
Miscellaneous	
Land and improvement of site	$70,000
Freight on machinery and equipment: 1,000 tons @ $15	15,000
Water supply, laboratory, shop and office	60,000
Engineering service	200,000
Total cost of plant	$1,447,000
Annual fixed charges @ 15 per cent	$217,050

necessity for the removal and reconditioning of the catalyst. At the same time, operating expense is decreased by the reduction of the hydrogen loss through diminished purging.

However, in this study it is assumed that electrolytic hydrogen has a purity of only 99.9 per cent and that its utilization efficiency in the ammonia plant is but 90 per cent. Using these factors, it is found that slightly less than 75,555 cu.ft. of hydrogen measured at 20 deg. C. and 760 mm. (the conditions in Tables II and III) is required per net ton (2,000 lb.) of ammonia synthesized.

In the following it is assumed that all the hydrogen produced in the electrolytic cells will be converted into synthetic ammonia by a modification of the Haber process. With annual hydrogen production in cell plants of different capacities as shown in Table III, and with the corresponding synthetic ammonia plants operating

Table VII—Capital Requirement for Synthetic Ammonia Plant

Annual Capacity (350 Days) of 1,980,000 M Cu.Ft. Hydrogen

Nitrogen Plant	
Linde air column units, capacity 50,000 cu.ft. nitrogen per hour	
Three units @ $50,000, f.o.b. Hamburg, Germany	$150,000
Freight, duty, motors and erection: 60 per cent of units cost	90,000
Purification equipment: 60 per cent of units cost	90,000
Building and foundation: 50 per cent of units cost	75,000
350,000 cu.ft. nitrogen holder and accessories	65,000
Ammonia Plant	
Modified Haber units, capacity 25 tons ammonia per day	
Three units @ $200,000	$600,000
Erection: 15 per cent of units cost	90,000
Building and foundation: 12.5 per cent of units cost	75,000
Compression equipment, erected (3 compressors: 1 spare)	300,000
Building and foundation: 10 per cent of compression equipment cost	27,000
Miscellaneous	
Land and improvement of site	$90,000
Freight on machinery and equipment: 1,250 tons @ $15	18,750
Water supply, laboratory, shop and office	75,000
Engineering service	250,000
Total cost of plant	$1,995,000
Annual fixed charges @ 15 per cent	$299,250

350 days each year, the daily and hourly consumptions of hydrogen and nitrogen and the daily and yearly production of ammonia are as shown on Table IV.

A unit for the synthesis of ammonia by the modified Haber process consists of converters, circulators, filters, separators, double condenser sets, and starting heater, in addition to the compression equipment, which is housed separately. In Tables V, VI, and VII are given the capital requirements for synthetic-ammonia plants with capacities sufficient to consume the three different annual hydrogen productions shown in Table IV. Attention is directed to the fact that the capacities of the modified Haber units provided for are respectively 114, 117, and 126 per cent of the requirements.

In Tables VIII, IX, and X are given the annual operation and maintenance charges for the three synthetic ammonia plants described in Tables V, VI, and VII, respectively, and the net ammonia production cost in each case. It will be noted that the operation is credited for the oxygen produced in the Linde columns simultaneously with the required nitrogen, at the nominal price of 15 cents per M cu.ft. In all three cases the cost of required firm electric energy is taken at an average of 5 mills per kilowatt-hour, although this is appreciably more than the price that would have to be

Table VIII—Operation and Maintenance Expense of Synthetic Ammonia Plant

Annual Capacity (350 Days) of 8,750 Net Tons

Hydrogen, Table III: 578,839 M cu.ft. @ 32.51 cents per M			$185,530
Power, 1,500 kw.-years @ 5.0 mills per kw.-hr			65,700
Labor, 350 days per year.			
Nitrogen plant,	3 men @ $6	$6,300	
	3 men @ 5	5,250	
Purifiers,	3 men @ 6	6,300	
Ammonia plant,	3 men @ 6	6,300	
	3 men @ 5	5,250	
Compressors,	3 men @ 6	6,300	
	3 men @ 5	5,250	
General,	3 men @ 5	5,250	
Supervision,	foremen, chemists, clerks, etc	35,000	81,200
Water, 200 gal. per minute, 350 days, @ 7.5 cents per M gal			7,560
Maintenance			
Nitrogen plant,	7.5 per cent of units cost	$4,875	
Purifiers,	7.5 per cent of equipment cost	2,925	
Ammonia plant,	2.0 per cent of units cost	4,000	
Compressors,	3.0 per cent of equipment cost	4,050	15,850
Materials			
Nitrogen plant		$9,000	
Purifiers		5,500	
Ammonia plant		8,000	
Compressors		6,800	29,300
Royalty, 7,661 tons of ammonia @ $3 per ton			22,983
Operation Cost			$408,123
Fixed Charges, 15 per cent of capital requirement			131,813
Total Production Cost			$539,936
Ammonia Made, net tons			7,661
Cost of Ammonia Without Oxygen Credit, per ton			$70.48
Oxygen Credit, 46,928 M cu.ft. @ 15 cents			$7,039
Net Production Cost of 7,661 Tons of Ammonia			$532,897
Net Production Cost per Ton of Ammonia			$69.56

paid under the conditions set up. For example, under the least favorable conditions, with an electrolytic cell plant of 30,000 kw. capacity, surplus off-peak energy is available for operation of the ammonia plant during 61.7 per cent of the time (Table I) at a cost of 1.66 mills, so that purchase of firm power to meet the deficiency of off-peak energy is necessary only 38 per cent

Table IX—Operation and Maintenance Expense of Synthetic Ammonia Plant

Annual Capacity (350 Days) of 17,500 Net Tons

Hydrogen, Table III: 1,122,385 M cu.ft. @ 32.12 cents per M			$360,504
Power, 2,400 kw.-years @ 5.0 mills per kw.-hr			105,120
Labor, 350 days per year			
Nitrogen plant,	3 men @ $6	$ 6,300	
	3 men @ 5	5,250	
Purifiers,	3 men @ 6	6,300	
Ammonia plant,	6 men @ 6	12,600	
	6 men @ 5	10,500	
Compressors,	3 men @ 6	6,300	
	3 men @ 5	5,250	
General	6 men @ 5	10,500	
Supervision,	foremen, chemists, clerks, etc	50,000	113,000
Water, 300 gal. per minute, 350 days, @ 7.5 cents per M gal			11,340
Maintenance			
Nitrogen plant,	7.5 per cent of units cost	$7,500	
Purifiers,	7.5 per cent of equipment cost	4,500	
Ammonia plant,	2.0 per cent of units cost	8,000	
Compressors,	3.0 per cent of equipment cost	6,750	26,750
Materials			
Nitrogen plant		$16,000	
Purifiers		10,000	
Ammonia plant		14,000	
Compressors		12,000	52,000
Royalty, 14,855 tons of ammonia @ $3 per ton			44,565
Operation Cost			$713,279
Fixed Charges, 15 per cent of capital requirement			217,050
Total Production Cost			$930,329
Ammonia Made, net tons			14,855
Cost of Ammonia Without Oxygen Credit, per ton			$62.73
Oxygen Credit, 97,660 M cu.ft. @ 15 cents			$14,649
Net Production Cost of 14,855 Tons of Ammonia			$915,680
Net Production Cost per Ton of Ammonia			$61.64

of the year. Even with a price of 1 cent per kilowatt-hour for firm energy, the average annual cost of all energy in the ammonia plant will be less than 5 mills per kilowatt-hour, the cost price set up in Tables VIII, IX, and X.

It is possible that, with such low hydrogen costs as are shown in Table III, it would be more economical to obtain the nitrogen required for the ammonia synthesis by the combustion of the oxygen in air with hydrogen to form steam, and, by subsequent condensation,

Table X—Operation and Maintenance Expense of Synthetic Ammonia Plant

Annual Capacity (350 Days) of 26,250 Net Tons

Hydrogen, Table III: 1,567,357 M cu.ft. @ 31.48 cents per M			$493,451
Power, 3,300 kw.-years @ 5.0 mills per kw.-hr			144,540
Labor, 350 days per year			
Nitrogen plant,	3 men @ $6	$ 6,300	
	3 men @ 5	5,250	
Purifiers,	3 men @ 6	6,300	
Ammonia plant,	9 men @ 6	18,900	
	9 men @ 5	15,750	
Compressors,	3 men @ 6	6,300	
	3 men @ 5	5,250	
General,	9 men @ 5	15,750	
Supervision,	foremen, chemists, clerks, etc.	65,000	$144,800
Water, 400 gal. per minute, 350 days, @ 7.5 cents per M gal.			15,120
Maintenance			
Nitrogen plant,	7.5 per cent of units cost	$11,250	
Purifiers,	7.5 per cent of equipment cost	6,750	
Ammonia plant,	2.0 per cent of units cost	12,000	
Compressors,	3.0 per cent of equipment cost	8,100	38,100
Materials			
Nitrogen plant		$22,000	
Purifiers		14,000	
Ammonia plant		19,500	
Compressors		16,500	72,000
Royalty, 20,745 tons of ammonia @ $3 per ton			62,235
Operation Cost			$970,246
Fixed Charges, 15 per cent of capital requirement			299,250
Total Production Cost			$1,269,496
Ammonia Made, net tons			20,745
Cost of Ammonia Without Oxygen Credit, per ton			$61.20
Oxygen Credit, 136,378 M cu.ft. @ 15 cents			$20,457
Net Production Cost of 20,745 Tons of Ammonia			$1,249,039
Net Production Cost per Ton of Ammonia			$60.21

to obtain the substantially pure residual nitrogen. The cost of plant required for this method of obtaining nitrogen is only about 25 per cent of that for a plant of equivalent capacity producing nitrogen and oxygen by cryogenic fractionation of air, the method set up in Tables V, VI, and VII. Attention is directed to the fact that the nitrogen capacities provided for in Tables V, VI, and VII are respectively 280, 240, and 258 per cent of the requirements, these large excess capacities

Table XII—Unit and Available Nitrogen Values of Various Nitrogen Materials

Material	Value, Dollars	Value per Lb. of Available Nitrogen, Cents
Synthetic Ammonia	110.00 per ton	6.68
Ammonium Sulphate	29.00 per ton	6.84
Saltpetre	23.00 per ton	6.98
Cyanamide	1.10 per unit	6.98
Ammonium Sulphate-Nitrate	36.00 per ton	6.81

being supplied as insurance against the interruption of operation.

As a further insurance of continuous operation, gasholder storage capacity has been provided for in each case sufficient for about six hours' average nitrogen production. No storage for oxygen from the Linde air columns is provided, because it was assumed that this would be mixed with the oxygen produced in the electrolytic cell plant.

Table XI summarizes all data to show the indicated net profit on the investment after providing for fixed charges of 15 per cent. The synthetic ammonia is assigned a value therein of $110 a net ton, which is equivalent to a price of only 6.68 cents per pound for available nitrogen. It is assumed that the electrolytic oxygen is sold at a price sufficient to cover its pro rata production cost, and that the byproduct oxygen produced by the air columns is worth 15 cents per M cu.ft.

To show the reasonableness of the value set up for synthetic ammonia in Table XI, there are given in Table XII the approximate values that must be placed upon different materials that are used to provide fixed nitrogen in order to bring the cost of their available nitrogen content down to a level approaching the equivalent of ammonia at $110 a ton. Even with the extremely low values set up for these other nitrogen sources, it will be noted that the values derived therefrom for their available nitrogen content all are higher than the value equivalent to $110 for synthetic ammonia. Comparison of these low equivalent values for other fixed-nitrogen sources with current and average market prices for the same materials indicates that a valuation for synthetic ammonia greater than $110 a ton is justified, and that the net profit from the whole operation, after substantial provision for fixed charges, probably will be larger than indicated. The data given above would therefore seem to prove the premise that electrolytic hydrogen is economically suitable as the raw material for ammonia.

Table XI—Summary of Data on Electrolytic Cell Plants and Equivalent Ammonia Plants

Capital Requirements

Cell Plant		Ammonia Plant		Total Cost Both Plants, Dollars
Capacity, Kw., A.C.	Cost, Dollars	Capacity, Tons	Cost, Dollars	
10,000	794,000	8,750	878,750	1,672,000
20,000	1,573,000	17,500	1,447,000	3,020,000
30,000	2,097,000	26,250	1,995,000	4,092,000

Annual Operation Costs of All Plants

Cell Plant		Ammonia Plant		Total Annual Operation Cost, Dollars
Capacity, Kw., A.C.	Annual Cost, Dollars	Capacity, Tons	Annual Cost, Dollars	
10,000	159,195	8,750	408,135	567,330
20,000	304,806	17,500	713,279	1,018,085
30,000	425,627	26,250	970,246	1,395,873

Quantities and Estimated Values of Products

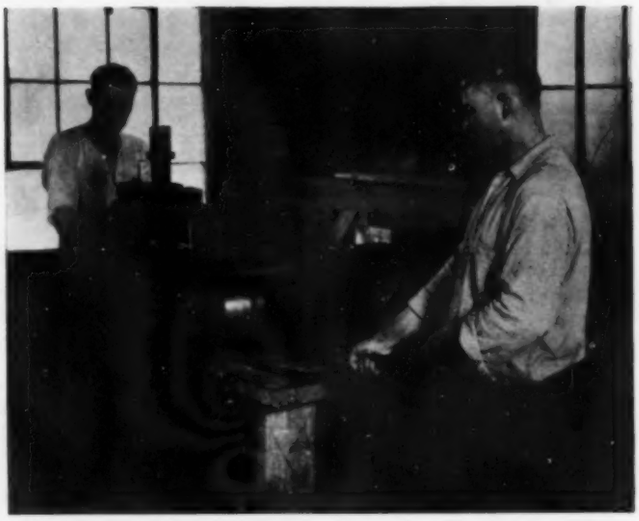
Oxygen From Cell Plant			Oxygen From Nitrogen Plant			Ammonia			Aggregate Value of All Products
Made, M Cu.Ft.	Value Unit	Value Total	Made, M Cu.Ft.	Value Unit	Value Total	Made, Tons	Value Unit	Value Total	
289,419	32.15c.	$92,765	46,928	15c.	$7,039	7,661	$110	$842,710	$942,514
561,193	32.12	180,252	97,660	15	14,649	14,855	110	1,634,050	1,828,951
783,678	31.48	246,726	136,378	15	20,457	20,745	110	2,281,950	2,549,133

Indicated Profit on Investment

Capital Requirement	Aggregate Value of All Products	Aggregate Annual Operation Cost	Fixed Charges @ 15 Per Cent: Cell Plant	Ammonia Plant	Total	Total Production Cost	Excess of Value Over Production Cost	Indicated Net Profit on Capital, Per Cent
$1,672,750	$942,514	$567,330	$119,100	$131,813	$250,913	$818,243	$124,271	7.43
3,020,000	1,828,951	1,018,085	235,950	217,050	453,000	1,471,085	357,866	11.85
4,092,000	2,549,133	1,395,873	314,550	299,250	613,800	2,009,673	539,460	13.18

Letting the Specialist Prescribe Corrosion Remedies

EDITORIAL STAFF ARTICLE



Experimental Rolling Mill for Corrosion-Resistant Alloys

INDUSTRY has become conscious of the inherent possibilities of alloys to solve its corrosion problems, and is now rapidly introducing them for materials of construction in nearly all branches of chemical production. In the petroleum-refining industry alone the yearly bill for replacements due to corrosion amounts to over $15,000,000, or the equivalent of 1 cent per gallon of gasoline produced. And this represents the annual loss in only one of the many process industries.

Alloy manufacturers are offering the chemical engineer a valuable service by assisting in the selection of a material to be used in the construction of chemical equipment; not from an altruistic motive but because it is to their interest to see that their alloys are used only if suitable for the specific purpose. Their knowledge of the adaptability of the alloys, and the type of service that is available to the chemical engineer who is considering the use of these materials, can be exemplified by the experience of the Duriron Company, one of the oldest concerns devoted entirely to the production of corrosion-resistant alloys. In 1912, P. D. Schenck, then president of the Dayton Malleable Iron Company, became interested in this type of alloy, and he equipped a small laboratory at home for the investigation of his basic idea: that the addition of a sufficient quantity of silicon to iron would increase its resistance to corrosion. His efforts and enthusiasm were rewarded by the high silicon-iron alloy later known as Duriron. Recognition of the corrosion-resisting properties of this alloy resulted in a large order from a South American chemical company. In 1913, Schenck left the Malleable iron company and organized the Duriron Castings Company, which in 1920 became the Duriron Company.

Continued research has improved the strength of the castings of this high-silicon alloy by lowering the quantities of silicate impurities as well as blowholes and gas pockets. Because of the nature of this product, it can be produced only in castings, and in such form is almost indispensable in many process industries. However, it was evident that it was necessary to supplement this material with alloys that could be machined into other shapes, and a series of aluminum bronzes was developed. It was found that small additions of manganese, nickel, or iron to the aluminum bronze made it possible to roll and machine this material. Then, with an appreciation of the advantages offered by chromium and nickel, research facilities were expanded and work commenced which has resulted in the development of the group of Ni-Cr-Si alloys, which are more resistant to certain corrosives and are more easily worked than most alloys. Metallurgists are engaged now in an investigation of proper methods of both acetylene and electric welding of these alloys.

In the well-equipped laboratory, a staff of metallurgists responsible for the development of alloys first tests the experimental melts by exposing them to the action of several corrosive solutions. If the preliminary test indicates worth-while resistance, the specimens are put through an elaborate series of tests, consisting of exposure of various acids at different strengths and temperatures. The specimens are also subjected to both wet and dry chlorine and to sulphur-dioxide gases.

In addition to investigating the chemical properties, a careful study is made of the mechanical and physical properties. A semi-commercial rolling mill equipped with rolls for working sheets or bars and sheets, a 50-lb. Moore 'Lectro Melt, 35-kva. high-frequency Ajax induction furnace, a gas-fired muffle furnace, and a hammer is used in this work.

The extensive laboratory facilities, the research staff employed in the development of alloys, and a staff of chemical engineers familiar with the problems of the pulp and paper, petroleum refining, and other process industries, are available for consultation, in assisting the chemical engineer in the selection of corrosion-resisting materials, and in the adaptation of these materials to the industry. These manufacturers of corrosion-resisting materials urge the prospective user to submit his problem with every possible detail of the conditions under which the material will be used. It often happens that some detail that seems inconsequential to the chemical engineer will prove to be the deciding factor in the selection of the alloy. Examples of some of the problems that have been solved by this co-operation between maker and user are as follows:

The chief engineer of a refining company came to

Dayton a few years ago, bringing with him an armful of blueprints. These prints showed a proposed light-oil treating installation for the company's plant. The management of that plant had found its treating equipment inefficient and unsatisfactory in many ways, and was prepared to spend a considerable amount of money to bring it up to date. The engineers of the oil company realized something special would be required and had designed an intricate and expensive means of treating light petroleum distillates with sulphuric acid. Their design consisted of a series of coils and angles for getting intimate mixes of light oil and acids. Their layout seemed to the Duriron engineers rather impractical. They told the chief engineer so, and with his approval and advice from the refiner's standpoint, these engineers designed a less expensive and more efficient equipment to do this work. The petroleum engineer stayed in Dayton three days, during which entirely new equipment consisting of Duriron mixing nozzles and elbow jets were designed. These, together with proportioning pumps and a standard line of valves and fittings, made possible an unusually efficient, continuous light-oil treating layout. The patterns and castings were made; the plant was erected and operating within six weeks. This equipment cut down treating costs, effected a saving in the quantity of acid used, showed a considerable improvement in the gasoline being shipped from the plant, and permitted the refinery to handle a wide variety of distillates successfully.

An insecticide manufacturer invited the Duriron company to submit plans for a plant to manufacture arsenic acid from white arsenic and nitric acid. The offset propeller-type agitator for arsenic-acid generators designed by the engineers cut down, to a considerable extent, the time required to finish a batch and made possible the use of smaller-sized generators, owing to the reduction of foam. The special white arsenic feeds eliminated certain hazards to the workmen. By combining such specialties with the standard line of condensers, exhaust fans, and so on, there resulted an efficient plant for large-scale production. These improvements have since been generally adopted by the industry.

The paper industry has used crude and inefficient methods for feeding alum to the beaters. In conjunction with the engineers of a paper mill in the Miami Valley, a means of dissolving alum by introducing steam under medium pressure in a tank containing lump or pulverized alum was developed. The steam jet designed for this purpose was inexpensive and resulted in dissolving alum about as fast as one workman could untie sacks and dump the contents into the tank. By means of a centrifugal pump, the alum solution was pumped to a storage tank whence it was fed to the beaters through a gravity line and measured through calibrated tanks, so that all possibility of error in the quantity of alum supplied to a beater was eliminated.

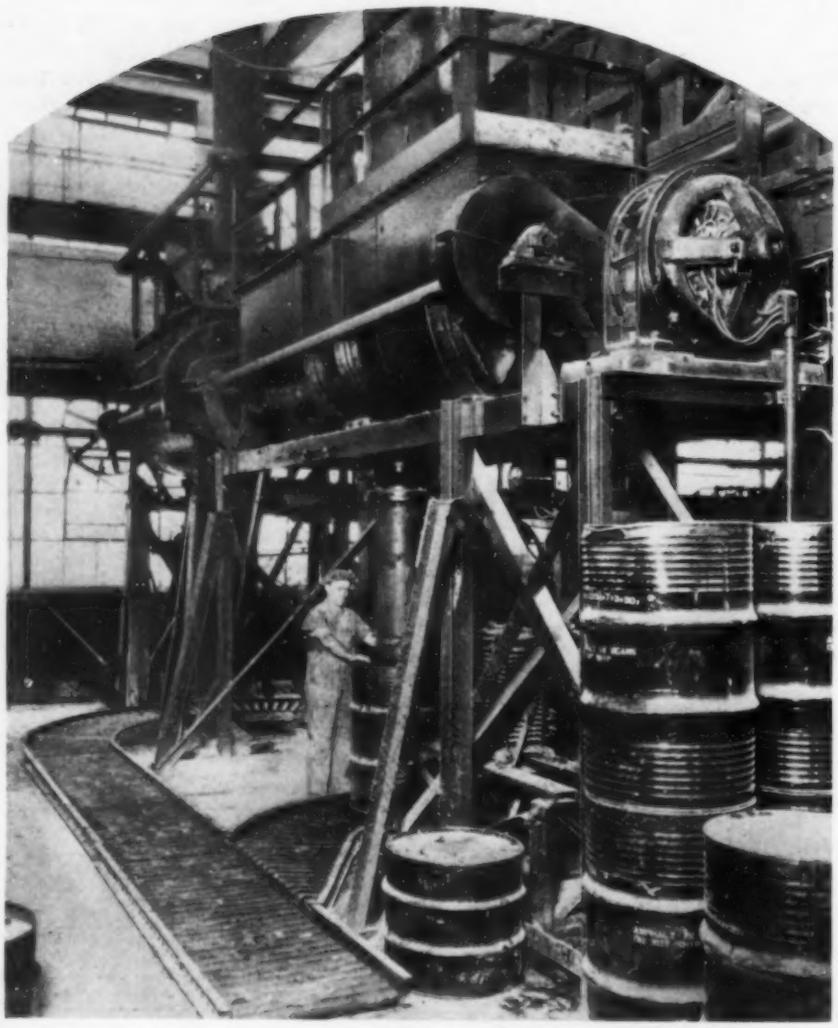
The steel industry had long been troubled by the difficulty of heating acid-pickling baths in the cleaning of steel. The alloy manufacturer became interested in this problem, and designed a jet heater. This resulted not only in efficient use of steam but also agitated the acid pickling solution so that pickling was effected at an increased rate. This particular means of heating a pickling bath has been adopted by the steel industry and results in a saving of thousands of dollars annually. The same jet is being used also in the textile industry as a mixing device in the manufacture of hypochlorite bleaching solutions. In this process, the chlorine tanks are connected up to the jets, so that advantage is taken of the pressure to produce the circulation in the make-up tanks required for efficient absorption and dissipation of heat.

While these are actual examples of the service that one alloy manufacturer has rendered, they are the type that practically every producer will give to the chemical engineer interested in using alloys for construction of chemical equipment.

A 35-kva. High-Frequency Ajax Induction Furnace Used for Preparing Experimental Alloys

Producing Clay-Type

ASPHALT



Loading Cold Mastic Material Into Steel Drums. Beaters for Working the Fibrous Material Into the Asphalt Dispersion Are Shown Above

OF THE three general methods of utilizing asphalt, there is only one the conception of which is of recent date. The utilization of asphalt in dispersed form is truly a successful technical achievement and is worthy of consideration and discussion. Let us confine our discussion to the dispersions of asphalt in water.

All stable asphalt dispersions are three-phase systems; in other words, a dispersing agent must be present. This agent must be adsorbed at the surface of the particles of asphalt and must be permanent to such a degree as to prevent the coalescence of these particles until such time as the dispersion is applied to some specific use. The agent must be preferentially wet by water and also readily wet by asphalt in the absence of water.

There are two general types of dispersing agents: First, those that lower the surface tension of the water appreciably; and second, those which do not appreciably affect the surface tension of the water yet belong to that class of materials called colloids and are preferentially wet by water. In the first class we may place the sodium and potassium soaps of the fatty acids, napthenic acids and rosin, sulphonated oils, etc. In the second class belong the albumins, starch, gelatin, fine mineral powders, colloidal clays, colloidal minerals, and the like. It is with this second type of dispersion that this article will deal.

Let us list, as a matter of record, the general properties which a good commercial dispersion must possess. First a minimum of dispersing agent is desirable in order not to prevent complete coalescence; second, the asphalt must be satisfactory for the specific purpose; third, the dispersion must be stable to handling but must coalesce when applied at a point of consumption in a reasonable time; fourth, the dispersing agent must in no way harm the properties of the deposited bitumen; fifth, the viscosity of the dispersion must be suitable for the purpose and of constant properties (i.e., all batches must be the same); sixth, in the case of a stabilized emulsion, both the mobility and plasticity factors must be suitable.

In order to gain these objectives a dispersing agent of constant composition must be used. This calls for very accurate control of the particular substance used. The agent must also be an efficient dispersing agent, since, if this is not true, too high a concentration is necessary. This brings us to the actual production of the dispersions.

Let us consider a dispersion of asphalt using clay or clay-like mineral as the dispersing agent. If the dispersion is to be suspendable the mineral colloid must likewise be suspendable. To be suspendable it must be hydrated to a large degree. The mineral known as bentonite fulfills these stipulations to a greater degree than any other substance yet found. As may be concluded the chemical and physical properties of this mate-

Based upon a paper presented before the meeting of the Ottawa Section of the Society of the Chemical Industry.

DISPERSIONS

By J. MISCALL
The Flintkote Company,
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The Slurry of Clay and Water Is Prepared in the Blunger. Here the pH Value Is Adjusted for Different Clays and Asphalts

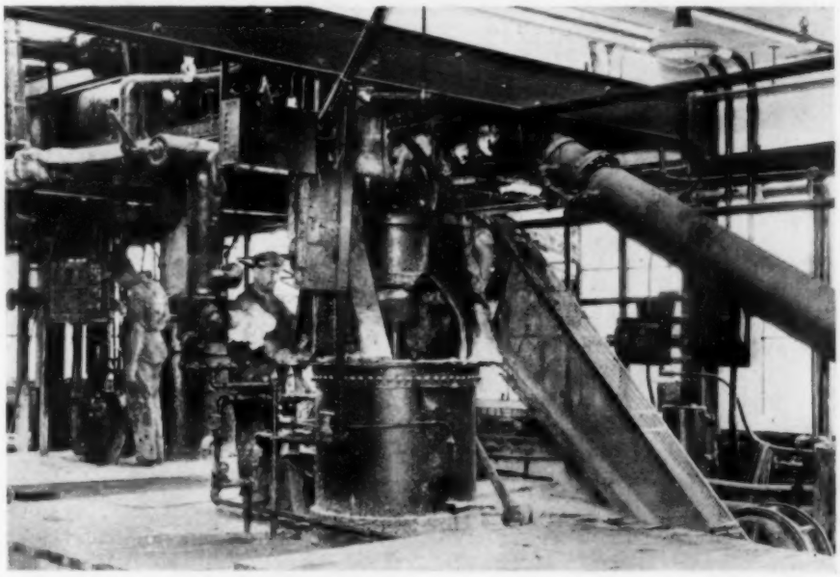
rial must be stringently controlled. The factors requiring important consideration include the presence of soluble electrolytes, degree of suspendability and hydration, hydrogen-ion concentration and plasticity. There are many variations in the composition of bentonites, the presence of which is not readily predetermined, but which have a vast influence upon its dispersing properties as well as upon the properties of the resulting product.

The process consists of adsorbing the bentonite from a dilute suspension in water at the asphalt-water interface, during the breaking up of the bituminous phase into small particles. In this type of dispersion the mechanism is not simply one of the conventional type of agitating together two mobile liquids until one is broken up into droplets in the other. There is operative in this case two opposing tendencies: namely, dispersion and coalescence; and where the phases are mobile as described, the tendency to coalesce is far greater than that of dispersion. To produce dispersion, therefore, with this type of material, conditions must be maintained which permit the asphalt under the interfacial trituration to pass through stages of elongation into strings, followed by a progressive attenuation of the strings until they become so fine that, by virtue of the surface tension of the asphalt and the viscosity of the surrounding media, the threads are broken into particles. These particles may be elongated or spherical, depending upon prevailing conditions. In order to produce this attenuation and subdivision in its most effective manner, the nature of the mechanical action, the internal friction developed, and the temperature, both of the added constituents and the mass undergoing dispersion, must all be carefully regulated.

It has been stated previously that the bentonite must be hydrated and suspendable; in other words, peptized by water. Therefore, during the process of dispersion this force of peptization must be overcome in order that the mineral colloid may go into the interface. Bentonites usually are so highly peptized that the phenomenon of adsorption does not readily take place; hence an adjustment is necessary. This includes changing the hydrogen-ion concentration of the system and generally shifting the reaction of the bentonite slip toward an isoelectric point, in order that the highly peptized bentonite may be adsorbed by the asphalt particles on their interface. As the force of adsorption remains the same, the net result of this adjustment is the production of a dispersing medium which will be more readily adsorbed from the slip, so that, in other words, an increased efficiency in the dispersion process is attained. An overly flocculated dispersion medium brings difficulties which exhibit themselves in the plasticity of the produced dispersion as well as in the process of dispersion.

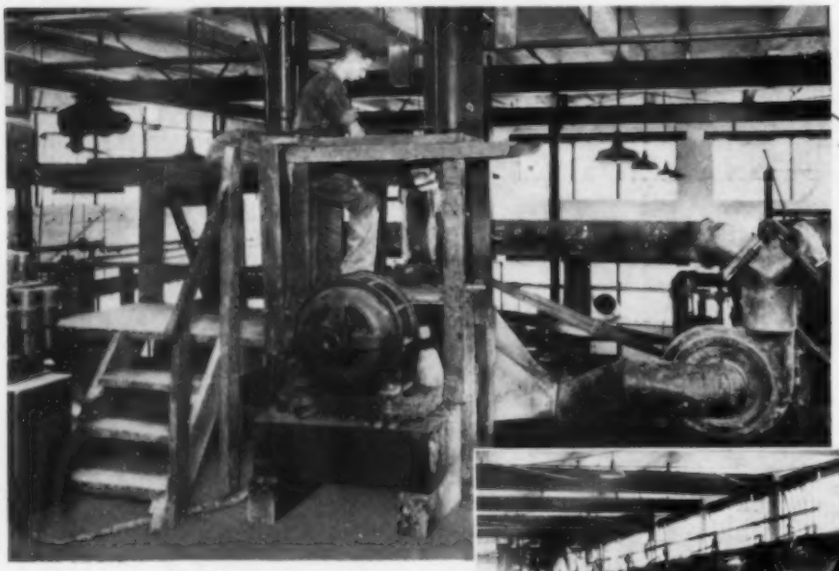
As these products are used on steel for corrosion-resistant purposes, it is well to note that the adjustment in this case must not bring the reaction of the

The Liquid Asphalt From the Storage Tank Above and the Bentonite Clay and Water Slurry From the Weir Box Are Made Into a Dispersion. The Process is Continuous



system too far down into the acid range of the pH scale, as such a reaction would tend to hasten corrosion of the metal base.

The dispersion particles in this case are not spherical but usually cigar-shaped. The particle size necessary for the production of one of these dispersions varies according to the specific use for which the product is intended. For some purposes the particle size must be from 8–10$^{\mu}$, while other instances demand only a particle size ranging upward from 10$^{\mu}$ to any reasonable degree, provided the relation between particle size and the viscosity of the system is sufficient to give suspendability to the product. There is no necessity of doing additional work to break up the particles to any finer degree than that called for by the specific use of the product, since the ultimate success depends upon its ability to coalesce and to form a continuous film of asphalt in which particle size plays no part. When this emulsion is used as a paint it must have the property of "leveling" itself upon the surface to which it is applied. This necessitates a control of plasticity. Mobility must be controlled as well as the yield value. The latter may be taken as the lowest force which will produce flow of the dispersion. Generally speaking, a dispersion with a low yield value will level off or will have the property known in the paint industry as "length." Such a dispersion will have the property of flowing readily.



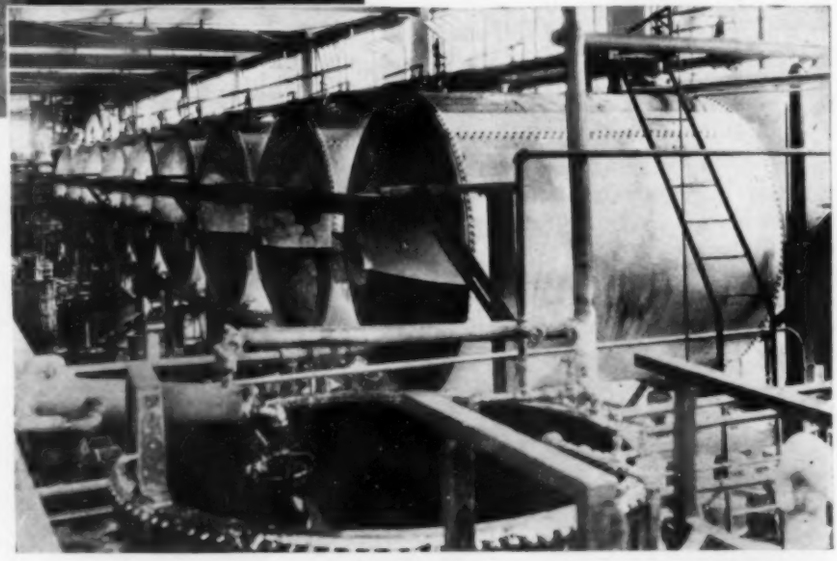
In Preparing Cold Mastic Product the Asbestos and Other Fibrous Materials Are Put Into an Abbé Grinder and Air-Blown Into Hot Dispersion in a Beater

In other cases a dispersion is required which will not flow when a layer of ¼-in. to ½-in. is built up by spraying. This requires a dispersion with an absence of "length"; i.e., it must have a so-called "false" body. This false-bodied dispersion must have a high yield value or the force necessary to produce a flow must be relatively high. The mobility of the long- and false-bodied dispersion may be varied according to the specific use to which they are being put.

A dispersion may be so prepared that it will be rather thick and false-bodied. Now, if this dispersion is beaten at a suitable temperature in a special type of high-speed beater, the yield point and mobility are decreased and the dispersion tends to assume the property of length.

Generally speaking, for dispersion containing a constant concentration of standardized bentonite, mobility and yield value are functions of water content, particle size, degree of flocculation of the system, and the smoothness of the protecting film. By smoothness of film is meant whether flocks of water are occluded in the clay or the film is deposited evenly over the surface of the asphalt. This may really be considered a type of flocculation, but since the treatment to control this factor is so different from that in the case of a true flocculation, a differentiation may be properly made.

The mechanism of coalescence of those dispersions using bentonite as the dispersion agent represents one of the most interesting as well as unique phenomena in the whole field of dispersions. Picture the system with which one has to work. Each particle of asphalt is completely surrounded by a film of hydrated bentonite. The volume of the hydrated dispersing agent is about seven times that of its dry volume. After water has evaporated from a film of this dispersion, coalescence begins close to the surface to which the material is applied. Bentonite and other solids concentrate at the interstices. The film shrinks in thickness to compensate for the diminution of volume.



In the Foreground Is a Preheater and Above Are Storage Tanks

What must happen in order that complete coalescence will take place? Micro-photography shows the presence of a honeycomb cellular structure of mineral colloid resulting from the dehydration. These cells, which formerly were the dispersing agent, are now porous, due to shrinkage caused by the great decrease in volume produced by drying. After the water leaves, the cell walls become permeated and wet by asphalt, and after a period of time complete coalescence takes place. When coalescence has come about, the films become impervious to water and redispersion in water can no longer take place.

Chemical Technology in Power Production

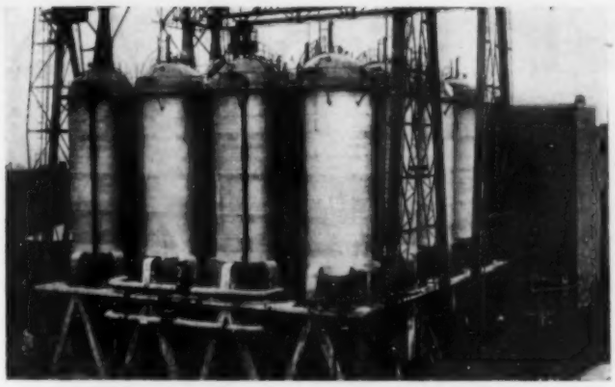
Special Correspondence From Berlin

VASTER than even the well organized and executed plans had foreseen, the World Power Conference held at Berlin from June 16 to 25 provided its guests with impressions and concentrated information that only the course of time can properly correlate. Despite the very efficient three-language system of transmission and the prior condensation of all papers, the manifold activities that packed the nine session days made a complete individual coverage of even one group of interests impossible. Chemical engineering turned out to be a greater factor than ever in the world's power equation, consequently the brief résumé of outstanding papers offered here must be understood to cover only this one phase of the 380 presented and discussed.

High-temperature treatment of coals was represented principally by economic studies from the larger countries. From the United States, J. C. Ramsburg evaluated the importance of the byproduct coke oven to the gas industry in this country, where it is confined mainly to the Northeast. The paper further lists 66 gas works, together with considerable detail on production and operation. The economic cycle of gaseous fuels in the United States was discussed by N. E. Bates and illustrated by economic tables comparing gas works and natural gas. One phase of this balance, hydrocarbon gas as power, was reviewed by Gustav Egloff, who dwelled on the 55,000 miles of natural-gas mains and 21,000,000 gal. of natural gas consumption from high-pressure cylinders in this country in 1929.

OF PARTICULAR interest were two papers that brought the gas industry in immediate bearing on nitrogen fixation. Decomposition of coke-oven gas by pressure and low temperature by the Linde-Bronn process, decreases its calorific value, according to P. Borchardt's report, but the resultant nitrogen-hydrogen mixture, free from CO, is surpassed in purity only by electrolytic hydrogen for ammonia synthesis. One of the features of this process is the absorption of CO in liquid nitrogen. Olefines and methane can be produced if desired; other gases, too, can be successfully altered by the process. The author makes an economic study of the production costs, declaring that electrolytic hydrogen, its only rival in quality, could compete only at a power cost of 0.15 cent per kilowatt-hour. A rough estimate of the I. G. process for hydrogen shows that it must exceed this figure greatly. Dealing with the British industry, C. P. Pollit makes a general survey of the nitrogen situation and then compares ammonia costs for different sources of hydrogen. Only with power at 0.10 cent per kilowatt-hour, he finds, does electrolysis underbid coke-oven or water gas. The latter is most favorable in manufacturing costs but coke-oven gas excels in capital costs per ton of NH_3. Natural gas also is suggested as a source of hydrogen, and, though he makes no cost analysis, the author demonstrates that in quantity alone it could satisfy any conceivable world demand. A plant is now being built for this purpose in San Francisco.

Following a survey of liquid fuels in the United States by W. C. Dickinson, an outstanding paper on cracking was presented by M. G. Hugel, who has tested the behavior of hydrocarbon mixtures under various conditions, ignoring time and catalysis. After reporting on these experiments, he concludes that cracking occurs only in the gaseous phase and that pressure conduces to the reaction, because denser gases improve heat transmission.



Kraftwerk Charlottenburg, Berlin, Visited by World Power Conference. Largest Ruths Steam Accumulator Plant in the World

Oil shale is still receiving study, especially from countries where natural petroleum is absent. Esthonia produces a fuel from Kukkersite which closely resembles cracked petroleum gasoline. In Italy, according to A. La Porta, the distillation of native bituminous rock with only a 4 per cent yield (by weight) would be profitable. Interesting test results have been gained at the Ragusa plant with regard to heat balance, furnaces, and operation. The product does not contain higher fractions, but is practically free from asphalt and is suitable for lubrication. The cost of production is $10 to $12 a ton of crude oil. At Fushun, Japan, a deposit with some 200,000,000 tons oil content occurs in connection with the coal seams. The economy of mining, however, is offset by the low fraction of oil in the shale (about 5.5 per cent). A special process was developed and set in operation at the end of last year. With a daily capacity of 54,000 tons oil, it is an excellent model of what may be done under adverse conditions.

NOTEWORTHY engineering papers were the series of researches on heat transmission between fluids and solids, by conduction, convection, and radiation, presented by the Americans W. V. A. Kemp, W. H. McAdams, H. C. Hottel, and R. H. Heilman. A mere review of their contents would deserve more space than this report offers. Further studies on heat mechanics were presented by the Russians, D. L. Timroth and M. W. Kirpitcheff.

Low-temperature carbonization was represented by papers from several countries. C. M. Lander's paper concerned the economic development in Great Britain; from France, M. Leroux reported carbonization tests above 650 deg. C. in the presence of hydrogen; and in line with an analysis of the advantages in co-ordinated gas and power works, A. Rachel, of Germany, gives an example of interconnected low-temperature carbonization plant, gas works, and electric-power station.

The complete set of conference papers will be available later this year as bound volumes. Meanwhile, individual papers are obtainable in limited quantities from O. C. Merrill, American Committee, World Power Conference, Chrysler Building, New York City.

FLUIDS HANDLING—III

By W. L. BADGER
and
W. L. McCABE

Respectively Professor and Assistant Professor of Chemical Engineering, University of Michigan, Ann Arbor, Mich.

The last of three articles on the transportation of liquids and gases. Although written primarily for the younger engineer, these articles contain much that can profitably be reviewed by the experienced engineer.

TWO EARLIER ARTICLES of this series, published in the June and July issues of *Chem. & Met.*, dealt with pipe, fittings, and valves; and pumping equipment, including acid eggs, air lifts, and ejectors, as well as reciprocating pumps. The present and last article of the series will take up the various types of rotary positive-displacement and centrifugal pumps, and will conclude with a brief discussion of fans, blowers, and compressors. The first of these groups is that of rotary positive-displacement pumps.

The most marked development in pumping practice in the past two decades has been the rapidity with which rotary pumps of all types have tended to supersede reciprocating pumps. The types that have been developed show fully as wide variations as the various types of reciprocating pumps.

Rotary pumps may be classified as either positive-displacement pumps or centrifugal pumps. These latter may be subdivided into volute and turbine pumps.

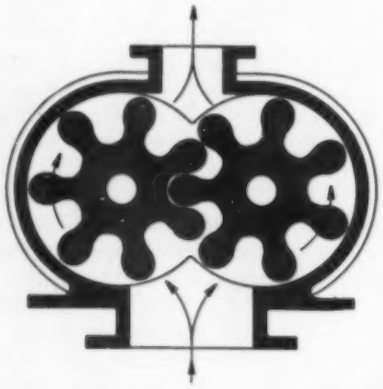


Fig. 1—Typical Gear Pump, Simplest Form of Rotary Positive-Displacement Pump

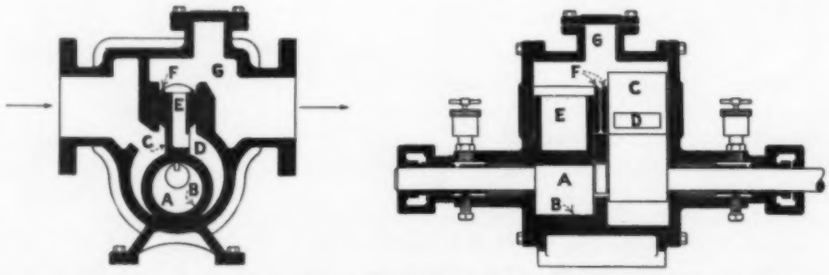


Fig. 2—Kinney Pump Is Typical of Considerable Number of Positive-Displacement Rotary Pumps Which Employ Rotating Pistons

A rotating cam, *A*, is mounted eccentrically in the working chamber. This slides inside the wearing ring, *B*, which, as the cam rotates, is brought in contact with the lining of the working chamber, the point of contact traveling around from inlet to outlet. Riding on top of the wearing ring is a sliding valve, *C*, which has an opening, *D*, at the right, near the bottom connecting to a passage, *E*, up through the valve. This valve slides vertically through a slide pin, *F*. As the rotating cam moves to the right from the position shown, the valve permits the liquid on the right of the wearing ring to be forced upward through the valve into the discharge chamber, *G*. The pump contains two rotating cams and two sliding valves at 180 deg. to each other, but both discharging into a common chamber.

Centrifugal pumps may also be classified as single-stage or multi-stage; open-impeller or closed-impeller; and single-suction or double-suction. These last four bases of classification are co-ordinate (i.e., any combination is theoretically possible).

Rotary Positive-Displacement Pumps—One type of rotary positive-displacement pump is the gear pump shown in Fig. 1. This pump consists essentially of two gears which mesh with each other and which run in close contact with the casing. Slugs of liquid are caught between the gear teeth and the casing, carried around next to the casing, and forced out through the discharge pipe. Such a pump handles viscous or heavy liquids, develops high pressures, and gives a discharge nearly free from fluctuations and independent of discharge pressure. The number of teeth varies from two or three on each wheel to a considerable number, as shown in the figure. The two or three lobed pumps usually are known as cycloidal pumps, although in the strict sense of the word the gear pumps also are cycloidal. A cycloidal pump adapted for transporting gases is discussed later and illustrated in Fig. 14.

There are many types of rotary positive-pressure pump other than the gear type. Most of them cannot be mentioned here, but to give an illustration of one form of construction employed, the Kinney pump is shown in Fig. 2. It is completely described in the caption accompanying the drawing.

Since the performance of all positive-displacement rotary pumps depends on maintaining a running fit between the rotating member and the casing (and in the case of gear pumps, between the gears also) it is not possible to use these pumps on liquids that carry solids in suspension. Although pumps of the cycloidal or rotary positive pressure type can be used on any clear liquid, they are most commonly used on viscous liquids and will handle quite stiff pastes. Semi-fluids, waxes, and similar materials can be handled with these pumps if the speeds are not too high. If the discharge valve of such a pump is closed, while the pump is running, the pressure developed will either stop the pump or cause breakage. The discharge rate of these pumps is directly

This is the last of three articles which will later appear at greater length as one chapter of a book by the authors to be published as part of the Chemical Engineering Series by the McGraw-Hill Book Company, under the title of "Elements of Chemical Engineering."

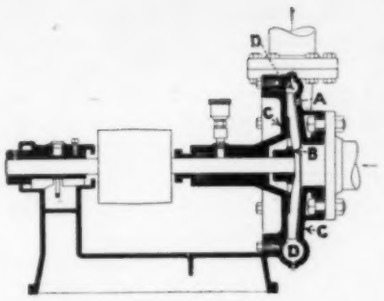


Fig. 3—Single-Stage, Single-Suction, Open-Runner Volute Pump Is Simplest Form of Centrifugal Pump

proportional to their speed, provided the contact between rotating parts and casing is good. These last two characteristics sharply differentiate these pumps from centrifugal pumps.

Centrifugal Pumps—The general class of centrifugal pumps probably is the most important type of pump at present. This class has been developed to the point where some form of centrifugal pump can be found for practically every service. Centrifugal pumps are of two distinct types, volute pumps and turbine pumps, which distinction will become more apparent as the pumps are described.

Volute Pumps—The simplest form of centrifugal pump is the single-stage, single-suction, open-runner volute, shown in Fig. 3. The most important member of the centrifugal pump is the impeller or runner, *A*.

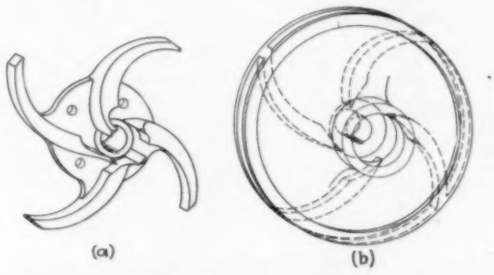


Fig. 4—Single-Suction Open Impeller at Left; Double-Suction Closed Impeller at Right

This consists essentially of a series of curved vanes extending from a hub, *B*. The simplest form of impeller, the open single-suction, is shown in Fig. 4*a*. This is mounted in the casing, *C*, of the pump of Fig. 3, in such a way that the two halves of the casing are as nearly as possible in contact with the surface of these vanes. Water entering at the suction connection is thrown outward by the rotation of the vanes. As the liquid leaves the vanes and enters the volute, *D*, of the casing, its velocity is decreased. According to Bernoulli's theorem, therefore, its pressure must be correspondingly increased, and this increase in pressure is a measure of the head developed by the pump.

The open-runner, single-suction pump is the cheapest of all centrifugal pumps, but it is also the least efficient. There are two main power losses in this type of pump. First, the water which is thrown out radially by the vanes must suddenly change its direction as it enters the volute. Any such sudden change of direction involves turbulence, which consumes power in the form of friction. Second, these are cheap pumps and therefore not accurately finished. The fit between the impeller and the casing usually is poor, and therefore there is leakage from the discharge side back to the suction side.

To prevent this loss by leakage from the discharge side to the suction side, the closed impeller shown in Fig. 4*b* has been developed. In this case the vanes of the impeller are inclosed between two sheets of metal. Consequently, to prevent back leakage, it is only necessary that a close fit be maintained between the outer circumference of the impeller and the entrance to the volute, or between the hub of the impeller and the corresponding point on the casing. These clearances can be maintained by inserting renewable wearing rings, and the back leakage thus be reduced to a minimum.

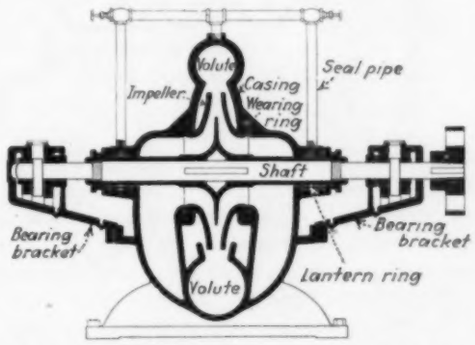


Fig. 5—Double-Suction, Closed-Impeller Volute Pump Minimizes End Thrust and Short-Circuiting

It is obvious that in such a pump as is shown in Fig. 3 the liquid exerts an unbalanced hydraulic pressure which tends to pull the impeller away from the shaft. This produces an end thrust on the bearings which is not easily taken up on the type of bearing usually furnished for such a cheap pump. To avoid this end thrust the double-suction impeller was developed. This consists essentially of two such runners, as in Fig. 4*b*, placed back to back and united in one casting. Fig. 5 shows a double-suction, closed-impeller volute pump. From this drawing it will be seen how renewable wearing rings can be inserted at the proper points in order to eliminate back leakage. Such a pump will have much less end thrust on the bearings than the pump shown in Fig. 3. Most of the better volute pumps are of the double-suction, closed-impeller type. This type is

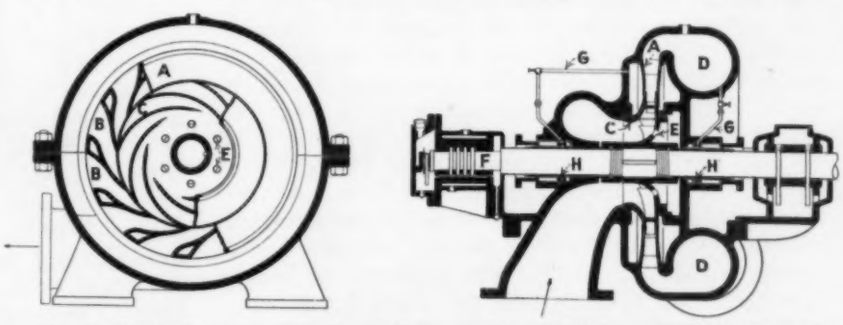


Fig. 6—Single-Stage Turbine Pump Gains Increased Efficiency Through Use of Diffusion Ring

It will be noticed that the diffusion ring, *A*, contains passages, *B*, which change gradually in cross-section and in direction, so that the liquid issuing from the tip of the impeller, *C*, is caught in these passages and turned gradually and smoothly into the discharge volute, *D*. The diffusion ring is stationary. The design of the impeller and the general construction of the pump are exactly similar to the corresponding features in volute pumps. Impellers of turbine pumps usually are single-suction impellers. As pointed out in the text, this results in an end thrust on the shaft. In this pump this is partly overcome by holes, *E*, in the impeller, so that the hydraulic pressure behind the impeller is partly equalized with the pressure in front of the impeller. The rest of the end thrust is taken up in the marine type thrust bearing, *F*. Seal pipes, *G*, and lantern rings, *H*, also are shown.

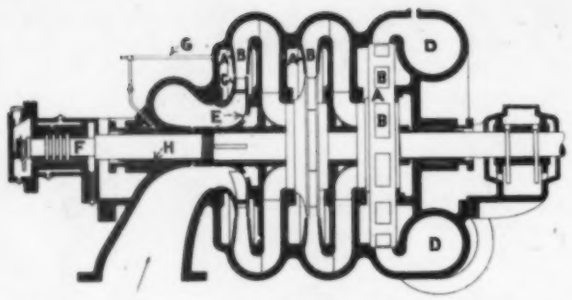


Fig. 7—For High Heads, Multi-Stage Turbine Pumps of This Type May Be Used

more efficient than the pump shown in Fig. 3, but is correspondingly more expensive.

If the suction side of a centrifugal pump is under a pressure less than atmospheric, air may be drawn into the pump and greatly decrease or entirely stop the discharge. To prevent this the better centrifugal pumps have the glands sealed by diverting a small quantity of liquid under the pressure of the discharge, through seal pipes, *B*, to lantern rings, *C*, in the packing.

Turbine Pumps—In the discussion of volute pumps it was indicated that the principal energy loss was due to turbulence that occurs at the point where the liquid changes its path from radial flow (due to the action of the impeller) to tangential flow in the discharge volute. Turbine pumps, as a class, are distinguished by the insertion of a diffusion ring whose function is to cause the liquid to make this change in direction smoothly and without shocks or eddies. Fig. 6 shows a single-stage turbine pump.

The maximum head that it is ordinarily practical to generate with a single impeller is about 75 to 100 ft. of water. If higher heads than this are desired, two or more impellers must be placed in series. The losses in a volute pump are serious enough so that if the liquid were discharged from one impeller to passages leading to another impeller, the over-all efficiency of the pump would be quite low and accordingly multi-stage volute pumps, although they are made, are uncommon. The turbine pump, however, provides means for taking the liquid from the tip of one impeller and delivering it with the minimum of losses to the inlet of the next impeller; and therefore makes it possible to design a multi-stage pump of reasonable efficiency.

In Fig. 7 is shown a multi-stage turbine pump in which heads up to 300 to 350 ft. may be generated. Here the first stage is shown as a section through both impeller and diffusion ring; the second stage shows the impeller in elevation and diffusion ring in section; and the third stage shows the diffusion ring in elevation. The parts are lettered to correspond to the description of Fig. 6. These pumps usually are relatively expensive and are practically impossible to build in special metals. Consequently, when a chemical engineer wishes to handle corrosive liquids at relatively high pressures, he usually is forced to turn to some form of reciprocating pump, and the turbine pump is reserved for clear, non-viscous, and non-corrosive liquids.

Self-Priming Pumps—One of the principal disadvantages of the centrifugal pump is that, since it depends on the inertia of a liquid to develop a pressure, it cannot pump if air enters the impeller. This is called air binding. Ordinary centrifugal pumps must be provided with some means for filling the suction line and the pump casing with liquid before the pump will discharge. This may be done by providing a check valve in the suction line, so that the casing and suction line will not drain when the pump is shut down. Another method is to provide a small priming pump, operated either by hand or by a steam jet, to remove air from the casing. Wherever possible, centrifugal pumps should be so located that the pump suction is under a positive head, and thus the necessity for priming will be eliminated.

Pumps may be made self-priming by the provision of suitable enlargements in the discharge and suction lines, and the proper location of the enlargements with respect to the pump. Certain pumps are designed especially for this purpose. One is the La Bour pump, which is shown in Fig. 8 and described in the accompanying caption.

Centrifugal Pump Performance—The action of a liquid in a centrifugal pump is more complex than in a

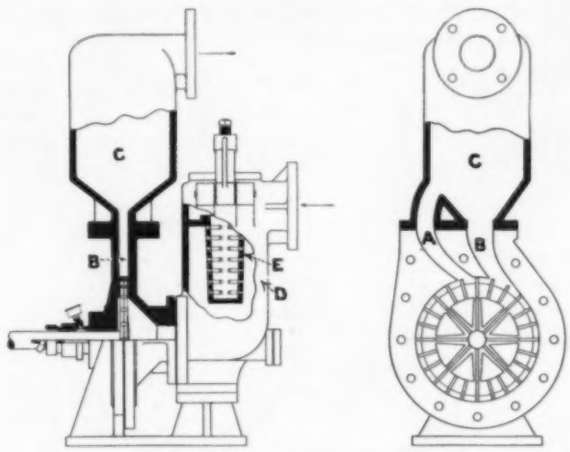
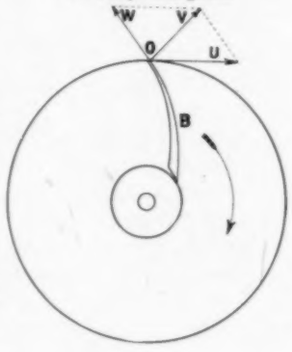


Fig. 8—LaBour Pump Employs Integral Priming Tank to Avoid Air Binding

The impeller is of a somewhat unusual shape and is not surrounded by a volute. Liquid is caught between the blades of the impeller and escapes through the discharge ports, *A* and *B*. The discharge connection, *A*, is the return from the priming tank, *C*. When there is air in the pump, it passes into the priming tank and out through the priming tank discharge connection. Any liquid which follows it drains back through the return into the pump casing. When the casing is entirely free from air, the pressure in the two discharge ports is substantially equal, so that there is little circulation back to the pump from the priming tank. The container, *D*, on the suction side has sufficient capacity so that when the pump is stopped and the liquid in the priming tank drains back into the pump casing, it will not be lost through the suction line. This particular container is provided with a suction strainer, *E*.

reciprocating pump. In Fig. 9, let *B* be the section of one vane of the impeller which is rotating in the direction shown by the arrow. A particle of water leaving the tip of the vane is traveling at a velocity, *U*, tangentially, due to the speed of the impeller itself; and at a velocity, *W*, parallel to the tip of the impeller due to its slipping along the surface of the vane from centrifugal force. The resultant of these two velocities is *V*, whose direction and magnitude obviously are determined by the relative values of *U* and *W*.

Fig. 9—Centrifugal Pump Velocity Diagram



In the volute of the pump, the velocity head corresponding to *V* is converted more or less completely to pressure

head by the change in cross-section in accordance with Bernoulli's theorem. Pressure developed by a centrifugal pump will vary with the vane angle, with the velocity of the tip of the impeller, with the friction losses within the impeller, and with the completeness of conversion of velocity head into pressure head in the pump casing. The exact interrelationship of these variables cannot be predicted mathematically, and consequently the form of centrifugal pump impellers and their performance are developed partly by calculation and partly by making a variety of impellers and subjecting them to actual test. The performance of any particular centrifugal pump is best expressed by means of curves.

A manufacturer usually supplies with every pump a copy of its characteristic curves. Such a set of curves for constant speed is shown in Fig. 10. This represents the performance of a low-speed, low-head pump. The efforts of the designer usually are directed toward making both head curves and efficiency curves as flat as possible, or at least flat over as wide a range as possible. Centrifugal pumps usually are rated on the basis of head and capacity at the point of maximum efficiency.

Increasing the speed of a centrifugal pump usually increases the head for any given rate of discharge and vice versa. Speed has less effect on the efficiency. The commonest method of driving a centrifugal pump is by a direct-connected motor, and therefore in practice most centrifugal pumps are constant-speed machines.

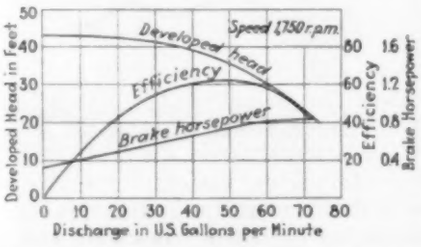


Fig. 10—Characteristic Curves of Low-Speed, Low-Head Centrifugal Pump

Head developed by a centrifugal pump is determined largely by the angle of the vanes and the speed of the tip of the impeller. Volume of the discharge, however, is determined by the cross-section of the passages. Consequently, centrifugal pumps for high heads and small volumes have impellers of large diameter but with narrow slots; while pumps for low heads and large discharges have impellers of small diameter with wide slots.

Reciprocating Pumps vs. Centrifugal Pumps—The advantages of reciprocating pumps in general over centrifugal pumps may be summarized as follows:

1. They can be designed for higher heads than centrifugal pumps.
2. Their first cost is less than that of the most efficient turbine pumps, capacity for capacity.
3. They are not subject to air binding, and the suction connection may be under a pressure less than atmospheric without necessitating special devices for priming.
4. They are more flexible in their operation than centrifugal pumps.
5. They operate at nearly constant efficiency over a wide range of discharge rates.

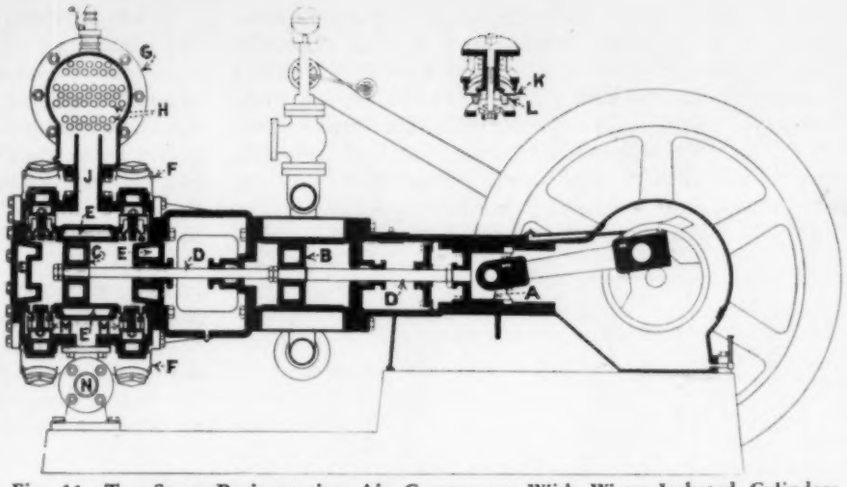


Fig. 11—Two-Stage Reciprocating Air Compressor With Water-Jacketed Cylinders and Intercooler Between Stages

A cross-head, *A*, a steam piston, *B*, and an air piston, *C*, are all mounted on a single piston rod, *D*. The valve gear for the steam cylinder is outside the plane of this section and does not show. The heads and walls of the air cylinder are provided with water jacket, *E*. The low-pressure air cylinder is behind the one shown in section and is slightly larger, so that part of its outline appears at *F*. It discharges into the intercooler, *G*, in which the air is cooled by water inside the pipes, *H*. The partly compressed and cooled air passes through *J* to the intake valves. These consist of a light steel ring, *K*, held against a seat by springs, *L*. The discharge valves, *M*, are similarly constructed. The discharge connection is at *N*.

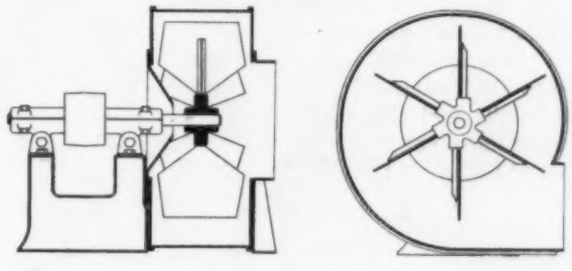
The advantages of centrifugal pumps over reciprocating pumps are:

1. Centrifugal pumps deliver liquid at uniform pressure without shocks or pulsations.
2. They can be directly connected to motor drive without the use of gears or belts.
3. Valves in the discharge line may be completely closed without injuring them.
4. They will handle large quantities of solids in suspension.
5. They can be built in many corrosion-resisting materials.
6. In moderate sizes, the efficiency of a good centrifugal pump is apt to be equal to, or somewhat better than, the average reciprocating pump.

The mere statement of the comparisons given above does not tell the whole story. If the reciprocating pump is a steam-driven pump, the value of its exhaust must be considered. Where steam is to be used for process heating and similar operations other than power generation, exhaust steam is of practically the same value as steam direct from the boilers. From this point of view a steam pump may be considered simply a reducing valve, and its efficiency is of no consequence so long as there is a use for its exhaust. Theoretically a centrifugal pump could be driven by a small steam turbine under the same circumstances, but steam turbines cannot be built in very small sizes, and in any case are much more expensive than a reciprocating steam cylinder doing the same work. Consequently, if a plant has use for exhaust steam, the steam pump is not always an inefficient pump.

In some cases where large numbers of pumps are used

Fig. 12—Plate Fan Used to Move Gases Against Pressures Up to About 5 In.



in widely separated places in the plant, it may be more economical to generate power at a central point by a non-condensing prime mover and send the exhaust steam directly to the point where it is to be used, distributing power to the individual pumps in the form of current. The other alternative, distributing high pressure steam to widely separated steam pumps and collecting their exhaust into a common header, obviously is less practical for this case. Many intermediate cases arise

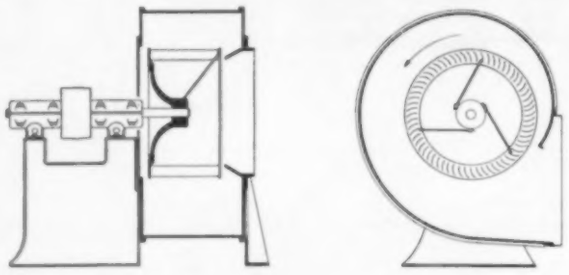


Fig. 13—Multiblade Fan Gives High Efficiency and Large Capacity

and no general rules can be laid down. It should be noted, however, that the present tendency is strongly in favor of motor-driven centrifugal pumps wherever they can be adapted to the service in hand, and reciprocating steam pumps are found much less frequently than 15 years ago.

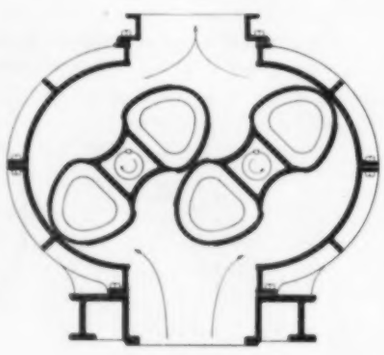
Transportation of Gases

When gases are to be moved, the device used is commonly called a blower or a compressor, although in principle and design it may be exactly comparable to some type of pump. The classification of blowers, therefore, is nearly parallel to the classification of pumps.

Ejectors—Gases may be moved at low pressures, by devices actuated by a steam or water jet, exactly like the types used for liquids. (See second article of this series.) The efficiency of the simplest forms of these devices is low and the pressures which they can overcome are small. They usually are used for producing a draft, for exhausting gases from an apparatus, and similar purposes. They can be made to discharge only against atmospheric pressure or pressures a few inches above atmospheric. Their principal advantage is that they are simple and cheap and need no attention. Highly specialized and efficient types for use as vacuum pumps have been developed.

Reciprocating Compressors—Where gases are to be delivered against pressures of the order of a few pounds per square inch or more, the device usually employed is a reciprocating compressor which is very similar in design to a piston pump. Its valves are made lighter; care is taken to keep the clearances small; and all parts are more carefully fitted; but otherwise their operation is like that of a piston pump.

Fig. 14—Two-Lobe Positive-Pressure Blower of Roots Type



When a liquid is moved by a pump its volume does not change appreciably with the increased pressure and therefore the work term in Bernoulli's equation is negligible. The heat equivalent of the friction losses is small and the mass of the liquid is great, so that ordinarily no appreciable temperature rise results. When a gas is compressed, however, its volume is decreased and therefore work is done upon it. This work, in addition to the frictional losses of the compressor, must appear as heat. The mass of the gas is relatively small, and consequently compressing the gas results in appreciable rises in temperature. For the most efficient operation of a compressor this heat should be removed and the gas discharged from the compressor as nearly as possible at the temperature at which it enters. For this reason the working cylinders of most air compressors are jacketed so that they may be water-cooled.

For higher pressures it is usual to operate compressors in two or more stages. A piston of large diameter is used for the first compression and the discharge from this cylinder passes to the second cylinder of smaller diameter for further compression. In such cases, in addition to jacketing the cylinders, the gas usually is cooled in tubular intercoolers located between the stages. The various stages may consist of cylinders in line and having their pistons on a single piston rod, or each stage may be a separate machine with its own piston rod and its own drive.

In Fig. 11 a two-stage air compressor with an intercooler between the cylinders is shown. This is a section through the high-pressure stage of a compressor of the second type mentioned in the preceding paragraph.

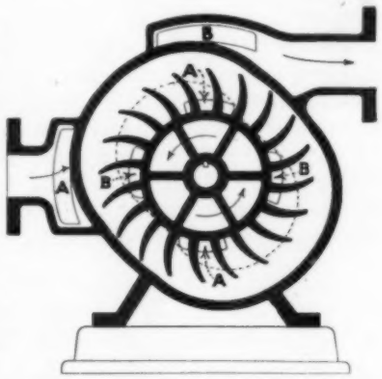


Fig. 15—Nash Hytor Compressor Rotates Liquid Which Serves as Hydraulic Piston

Fans — The commonest method for moving gases under moderate pressures is by means of some type of fan. These are effective for pressures from 2 or 3 in. of water up to 0.5 lb. per square inch. They may be classified into three types: the propeller type, the plate fan, and the multiblade type.

The propeller type is represented by the familiar electric fan and is of no great importance for moving gases in plant practice. A typical plate fan is shown in Fig. 12. This consists, as its name implies, of plate steel blades on radial arms inside a casing. These fans are satisfactory for pressures from 0 to 5 in. of water, have from 8 to 12 blades, and can be built for practically any capacity. Another variation of the steel plate fan has blades curved like the vanes of centrifugal pump impellers, and can be used for pressures up to 27 in. of water. Multiblade fans are illustrated in Fig. 13 and are useful for pressures of from 0 to 5 in. of water. It is claimed that they have much higher efficiencies than the steel plate fan. These fans will deliver much larger volumes for a given size of drum than steel plate fans.

Cycloidal Blowers—Any pump of the cycloidal or gear type can be used as a blower. When so used they generally have only two or three lobes on the rotating parts.

Such a blower is shown in Fig. 14. These blowers are used for pressures of from 0.5 to 10 or 12 lb. per square inch, but their maximum efficiency is obtained below 5 lb. Their principal advantages are simplicity and large capacity. Such blowers are often used for blast furnaces and for other similar services where very large volumes must be delivered against pressures too high for a fan.

One type of compressor which does not fall into any of the above classifications is the Nash Hytor. Such a pump is shown in Fig. 15. A central cylindrical rotor, carrying vanes around its circumference, is placed inside a casing which is approximately elliptical in shape. A sufficient quantity of liquid is placed inside the casing to seal the impeller at its points of least clearance from the casing, which correspond to the minor axis of the ellipse. The rotation of the impeller causes the liquid also to rotate, but centrifugal force keeps it against the casing. Therefore the liquid alternately advances toward, and recedes from, the center of the impeller, thus acting essentially as a series of liquid pistons. As these recede they suck in air from the inlet ports, *A*, and as they advance they compress it into the outlet ports, *B*. This type reaches its highest efficiency at discharge pressures from 8 to 12 lb. per square inch, but may be operated at pressures up to 20 lb. Since the pump contains no moving parts in mechanical contact with each other, the rotor may be made of any non-corrodible material; and the actuating liquid may be any liquid which is inert to the gas being handled. For example, this pump, using concentrated sulphuric acid as the liquid, is used to compress chlorine gas.

Centrifugal Blowers—The principle of the turbine pump may be adapted to the transportation of gases. Because of the relatively low density of a gas, the centrifugal force which can be developed by the rotation of the impeller is small, and therefore the pressures which can be produced are low. Without exceedingly careful design, the efficiency also is low. The construction is quite like a turbine pump, except that the rotating parts are made as light as possible. These blowers run at high speeds (4,000 to 6,000 r.p.m.) and cannot be made to develop pressures over 8 to 10 lb. per square inch even when built multi-stage. They operate best at pressures under 5 lb. They cannot be built in small units. Within the proper pressure range they are the most efficient type of blower yet developed, but they are very expensive machines.

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Safety Governs Choice of Electric Equipment in Powder Plant

Electric heating for buildings and process are features of Ohio powder plant

By C. COBURN

General Electric Company
Cincinnati, Ohio

NECESSITY for additional capacity, a few years ago, led the King Powder Company, of Cincinnati, Ohio, to seek a new location which would allow it to take advantage of better transportation facilities and improved labor conditions, and General Electric was asked to co-operate in laying out plans for the new plant.

Because of the extreme hazards of some of the processes necessary in the manufacture of black powder, it has been common practice to carry on these operations in small buildings widely separated from one another. The distribution of electricity presented an important problem of safe locations for circuits, motors, and controls.

Although central-station power could not be obtained when construction began, officials felt sure that it would be available in a comparatively short time. It was necessary, therefore, to lay out an isolated plant at minimum expense to feed a distribution system planned for the eventual use of central-station energy.

A small plant was installed, consisting of a 300-kw., 3-phase, 60-cycle, steam-driven generator, a switchboard, necessary boilers, and accessories. The 2,300-volt, 3-phase distribution system with step-down transformers is protected by cutouts and lightning arresters, and remote-control switches located at various points serve to isolate certain sections in case of trouble.

All motors, depending upon the service required, are of the squirrel-cage or wound-rotor type, and while no special control is used, the location is somewhat unusual. The motors and control equipment are installed at a distance from buildings housing the processes, and power is transmitted by belts and line shafts. The control equipment, located in the motor house, is mounted before a small opening in the building wall through which the operator may start or stop motors by compensators, drum controllers, or push-button stations. Since no lights can be used in the buildings, glass-inclosed, weatherproof, angle-type reflectors are mounted on goose-neck brackets outside the windows.

Although this equipment was sufficient for manufacture of black blasting powder in the granular form, the recent addition of the new "pellet line" required additional equipment. In this process, the powder is pressed into small pellets to be stacked in the form of sticks, the number of pellets used depending on the strength of charge needed. The sticks are wrapped in paper and dipped in paraffin for shipment.

A number of small buildings had to be heated, and drying ovens and a paraffin melting pot were among the necessary additional equipment. Electric heat seemed to be the solution. For heating the buildings, 10-kw., 220-volt, electric steam generators are used, each with a magnetic switch operated by the pressure governor on the heater. A three-heat snap switch also is wired in the circuit.

The steam generators and switches are mounted just outside the buildings to be heated (which average 12x18 ft. in size, with a height of 8 ft.). They are protected by small lean-to houses, thereby excluding all electrical wiring from the main buildings. Steam is piped from the generators to the radiators with return pipes for condensate. These steam generators have operated through one winter season and sufficient heat was produced during the coldest weather to make the buildings comfortable.

A duplicate steam generator is connected to a 110-gal. Dopp kettle which melts, and keeps at the proper tem-

perature, about 400 lb. of paraffin. The wiring and piping for the kettle were installed in the same manner as for the radiators. Temperature regulation is very close.

Pellets are thoroughly dried in Gehnrick drying ovens heated by separate electrical units. These units consist of a well-insulated cabinet containing the heating elements and a small motor-driven blower mounted on top. A Reed air filter supplies the cold air blown through the heaters, thence through 40 ft. of insulated pipe to the ovens. The correct temperature is maintained by temperature control instruments and a magnetic switch, while a temperature limit fuse is installed at the outlet of the heater units as an added precaution against excessive heat. The fan-motor line switch, overload devices, and temperature-control instruments are all interlocked. Three of these drying equipments, of 60 kw. each, are in operation and the installation of the fourth unit is under way.

A short time ago arrangements were made with a central-station company to purchase power, the existing generator being overloaded. The only change necessary was the substitution of an automatic for a non-automatic generator oil circuit breaker. The powder company, because of proper equipment installed, was entitled to credits from the power company of 15 cents per kilovolt-ampere of contract capacity, 5 per cent for having 2,300-volts service, and a power-factor bonus for having power factor above 85 per cent. After a month's operation the power factor of the whole plant was 96.5 per cent.

Therefore, the power company was able to offer an exceedingly attractive rate on the 450-hp. connected load in motors and the 24-hour electric heating demand of 460 kw., and the powder company was able to make the change to purchased power without delay and at practically no cost, because of properly planned equipment.

The powder company has ten electric steam generators and three drying ovens in operation at present. Since the plant has been operating on purchased power it has been found that the cost of power has been less than when operating from its own plant under the same load. Considerable load has been added since the change-over, which brings the cost per unit of power to a still lower figure.

There has been installed at this plant the following electric equipment:

Eight 10-kw., 220-volt, single-phase, 60-cycle electric steam generators having two 5-kw. standard water immersion heaters, operating at 8 lb. steam pressure for heating various buildings.

One 5-kw., 220-volt, single-phase, 60-cycle, electric steam generator having one 5-kw. standard water immersion heater, operating at 8 lb. steam pressure for heating a small building.

One 10-kw., 220-volt, single-phase, 60-cycle, electric steam generator having two 5-kw. standard water immersion heaters, operating at 40 lb. steam pressure, for heating the Dopp paraffin kettle. This steam generator consists of a suitable horizontal boiler shell with a steam dome located centrally. Shells are tested for a maximum pressure of 100 lb. and are equipped with a steam gage, safety valve, water glass and cocks, automatic pressure regulator, magnetic switch, and a 3-heat switch for each 5-kw. immersion heater. This arrangement of 3-heat switches allows the operator to RATE the steam generator from 1.25 kw. by increments of 1.25 kw. up to the maximum capacity of each generator. The generator is insulated with at least 2 in. of standard boiler insulation.

Acetic Acid From Cellulose Wastes

RECENT announcement that acetic acid is to be produced in the United States by a fermentation process, using as a source of cellulose corncobs and other waste cellulose materials, focuses interest on the British patent, No. 248,795, of Herbert Langwell, which, according to reports, covers the process to be used here.

The invention, in brief, consists in a process for the fermentation of cellulosic materials according to which the hydrogen-ion concentration is maintained within the limits of pH 5 to pH 9. To neutralize the acid produced by the fermentation and keep the pH within this range, neutralizing compounds of the alkalis or alkaline earths are added to the mash at appropriate times. These compounds include the oxides, hydroxides, carbonates, or bicarbonates of the alkali metals, including ammonium; or the same types of salts of the alkaline earth metals, including magnesium. In the latter case it is necessary to add from time to time compounds of alkali metals which cause the formation of insoluble alkaline earth compounds. This is found to be necessary in order to prevent a gradual decrease in fermentation speed through the reaction of alkaline earth carbonates to form soluble salts in the fermentation mass. It has been found that such soluble salts exert a powerful inhibiting action.

In addition to the features just described, the invention consists in using cellulosic materials which are wholly or in part in the form of naturally occurring substances containing suitable natural bacterial flora capable of bringing about fermentation at temperatures as high as 60 to 70 deg. C. without further inoculation. The inventor also provides for stirring or agitation of the mash to liberate the gas and prevent the cellulose from accumulating at the top of the liquid.

In the specifications there are given a number of examples of various mashes, together with yields. It is pointed out that the products will depend to some extent on the type, and largely on the quantity of nutrients provided for the bacteria. Certain raw materials may provide sufficient nutrients, but it usually is necessary to supply these artificially. For instance, in one example the inventor uses 12 kg. of dried (but not sterilized) corncobs which have been finely ground. The material is mixed with 180 liters of water to which there is added 1 kg. of dibasic sodium phosphate, 440 gm. of potassium chloride, and 200 gm. of ammonium chloride to serve as nutrients. There is a further addition of 5 kg. of finely ground $CaCO_3$ and 180 gm. of $NaHCO_3$ to bring the acidity to pH 7.5, and later, from time to time, 500 gm. more of $NaHCO_3$ to precipitate the soluble calcium compounds, which would inhibit the reaction.

During the subsequent 7 to 14 days which are required to complete the fermentation, temperature is maintained at 60 deg. C. and the agitation of the mash is continued most of the time. During the fermentation there are produced about 75 cu.ft. of gases and:

Acetic acid	1.5 kg.
Butyric acid	0.3 kg.
Alcohol	0.77 kg.

The gas consists, by volume, of 73.5 per cent CO_2, 26.4 per cent of H_2, and 0.1 per cent of CH_4. Had agitation been omitted the yield of alcohol would have been less, and of methane, more. Had the fermentation not been carried out under comparatively anaerobic conditions, some of the products would have been oxidized to CO_2.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

The Catalysis of SO_2 to SO_3

To the Editor of Chem. & Met.:

Sir:—A letter in your June issue, by T. R. Harney, entitled "Vanadium Catalysts for Sulphuric Acid," impels me to offer the following additional statements.

The system SO_2:O_2 with platinum as catalyzer is the classic example, scientifically and technically, for a catalytic process. Platinum acts upon SO_2:O_2 "with a rapidity unsurpassed by that of any other substance" (F. D. Miles, "Sulphuric Acid," p. 76). The rate at which the gases combine is so great that the highest conversions are obtained with the most rapid flow of the gases; the maxima of the conversion curves are from 150 cu.cm. up to a flow rate of 7,500 cu.cm. per minute within the temperature range of 400-480 deg. C., which gives the highest yields (F. D. Miles, loc. cit., p. 91):

Flow rate.....	150	300	1000	2500	7500 cu.cm. per min.
Conversions.....	99.5	99.7	97.5	94.0	87.5 per cent
Temperature.....	425	425	430	450	480 deg. C.

From the viewpoint of the chemical engineer this means that platinum contact plants have the greatest overload capacities.

As in all other processes in which platinum is used, so also in the sulphuric-acid contact process painstaking attempts have been made to eliminate this "expensive" metal in favor of a cheaper agent. Today vanadium is claimed to possess all the catalytic properties of platinum and to be a complete substitute as catalyzer in the sulphuric-acid process. The new contact masses contain "pseudomorphous dehydrated zeolites in which vanadium is combined in a non-exchangeable form and the active bases (silver, copper, cobalt, nickel) in an exchangeable form" (Jaeger-Bertsch patents). These masses produce conversions equal to that of platinum; contrary to platinum they are not poisoned by arsenic compounds.

Investigations conducted in recent years by B. Neumann and his co-workers give detailed information about the chemistry involved in the contact process using vanadium compounds as catalysts. (*Z. Elektrochem.* 34 (1928), 699; 35 (1929), 49; 36 (1930), 87). These investigations were made with asbestos or pumice as carrier and show that:

1. Heavy metal salts of vanadic acid are active catalyzers in the sulphuric-acid contact process; the following comparisons are given:

Silver vanadate					
Flow rate	150	300	500	750	cu.cm. per min.
Conversions	97.0	92.5	86.0	81.0	per cent
Temperature	450	465	487	500	deg. C.

Platinum									
Flow rate	150	300	150	300	150	300	150	300	cu. cm. per min.
Conversions	99.0	98.7	99.5	99.7	99.0	99.2	96.0	96.0	per cent
Temperature	400		425		450		500		deg. C.

2. Vanadic acid alone acts as catalyzer slower than platinum, even slower than silver vanadate.
3. Silver and copper vanadate, like platinum, are poisoned by arsenic compounds.
4. Pure vanadic acid (without any active bases) is not poisoned by arsenic compounds.

Briefly, at low flow rates the conversions of the vanadium compounds on pumice or asbestos nearly reach the efficiency of platinum; at higher flow rates (beginning with 300 cu.cm. per minute), the reaction rates slow down rapidly with these catalyzers whereas platinum keeps the high reaction rates even with very high flow rates within the temperature range of 400 to 480 deg. C. when highest conversions are possible. Only at 500 deg. C. and above, the reaction rates of these vanadium catalyzers reach the activity of platinum, "but the use of such high temperatures defeats the end in view" (F. D. Miles, p. 76).

The latest research (H. N. Holmes, A. L. Elder, *Ind. Eng. Chem.* 22 (1930), 471) with vanadium catalyzers in the most active form, peptized calcium vanadate mixed with calcium silicate (a combination which contains the vanadium compounds in a more even distribution through the catalytic mass than the catalyzers prepared according to the patents of Jaeger and in a finer distribution than the catalyzers of Neumann with pumice as carrier) points decidedly to the same results: The vanadic acid catalyst of this preparation develops at the low flow rate of 200 cu.cm. per minute and at 500 deg. C. an activity which produces a 98 per cent conversion of the theoretic conversion of 96 per cent, which means an output of 94 per cent SO_3. Silver vanadate produces under these conditions 95 per cent SO_3; the vanadic acid of the above preparation reaches, therefore, approximately the activity of the silver vanadate catalyzers.

There is, therefore, no difficulty to reach with vanadium catalysts at low flow rates the same conversions as with platinum at given temperatures, but the greatest difficulty is to reach "the high rate at which the gases can be combined, independently of the percentage yield; in other words, the weight of trioxide which, say, 1 lb. of catalyst will produce in an hour at a given temperature" (F. D. Miles, p. 89). The "joint action" of the two factors: highest flow rates, highest conversions, is, however, the decisive point of every contact plant.

The elimination of platinum and the substitution of vanadium compounds and other catalytic compounds has, besides, a very important economic aspect. According to H. N. Holmes and A. L. Elder (*loc. cit.*), 21 parts of vanadium metal are able to replace one part of platinum as catalyzer. According to the present market prices of these metals (1 kg. platinum, $1286; vanadic acid technical, $1.75 per pound; 1 kg. vanadium metal, $7) the following comparison is given:

Platinum 1 kg		$1,286
Loss, 40 g	$ 52	
Refining	93	
Return value of platinum		1,141
Net cost of catalyzer metal		145
(Low cost of carrier; no new equipment; no license fee.)		
Vanadium		
21 kg. vanadium metal		$ 147
(Cost of new catalyzer, specially made by an expert; cost of new patented equipment; no return value of catalyst.)		

The amount invested in platinum can be overlooked,

considering that the additional cost of patented apparatus, machinery, license fee, depreciation and so on, always by far offsets this investment. The high return value of platinum, on the other side, gives a very restricted meaning to the argument that platinum is an expensive metal. Very decided advantages have to be offered both in construction and over-all efficiency of the substitute contact masses to eliminate it from this strong position. The return value of platinum is often forgotten in calculations. An error also prevails in connection with the price of platinum, as when such statements as this are made: "platinum costs about two thousand times as much as vanadium" (Holmes and Elder, *loc. cit.*). The true proportion was 1 to 253 in February, 1930, and 1 to 184 in July.

J. S. STREICHER

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Newark, N. J.

De-confusing Terminology On Psychrometry

To the Editor of Chem. & Met.:

Sir:—There is a certain looseness in the terminology of psychrometry used by both engineers and periodicals. I refer to the term "percentage humidity" when this may refer to either "percentage absolute humidity" or "percentage relative humidity." Psychrometric tables of some authorities, notably Carrier and Bulkeley, are in terms of percentage relative humidity, while the Grosvenor, Lavine-Sutherland and Hatta tables make use of percentage absolute humidity.

Confusion of these terms may result in considerable error; for example, under the conditions 200 deg. F. dry bulb and 10 per cent humidity. On a Carrier chart (relative humidity) we find moisture equal to 0.0531 lb. of dry air; on a Grosvenor chart (absolute humidity), however, the moisture content appears as 0.22 lb. per pound, a discrepancy of 400 per cent. Now it happens that both of these are correct. The difficulty is one of definition, for 10 per cent absolute humidity at this temperature is equal to about 35 per cent relative humidity. When the latter point is correctly taken on the Carrier chart, the discrepancy disappears.

This simply proves that careless use of "percentage humidity" may often trap the unwary. It is highly desirable that, as long as the two forms must be employed, greatest care be taken to specify whether absolute or relative humidity is the quantity involved.

A. H. HEATLEY.

Chemist,
John Walter & Sons, Ltd.,
Kitchener, Ontario.

Demolishing the Container Drum

To the Editor of Chem. & Met.:

Sir:—A note by M. Szamatolski in the July issue of *Chem. & Met.* asked for a quick and simple method of disposition of drums around chemical plants.

At Edgewood Arsenal, a standard day's run was 365,000 lb. of bleach. Because of the large number of drums used, it was necessary to devise a quick method of disposition of these drums. The usual procedure, that known by most bleach men, is to cut the bottom out of the drum with an axe, the head already having been removed to remove the bleaching powder. The workmen then step onto the flattened drum. This procedure was so slow that it was out of the question where such large numbers of drums were segregated, therefore a new method had to be evolved.

Accordingly, a heavy platform about 8 ft. square was made by spiking 2-in. planks to a solid platform of railroad ties. Over this, a ½-in. boiler plate was attached by lag screws, the head being allowed to project above the iron. A heavy tower base made of cast iron was arranged with chains and a ring, so that it could be raised up with a three-point contact. A large railroad crane was brought down near the plant each night and one man fed the drums under the weight. The crane man lifted the weight and allowed it to drop free on the drum. One man removed the crushed drum, and another rolled the uncrushed drum under. Working in this manner and with the drums close by on a gentle slope, it was possible to crush two drums in a minute.

All of the bleach drums, caustic soda and carbide drums were entirely disposed of in this manner. The heavier drums, made to withstand pressure, were not so easily crushed and sometimes required two or more blows from the weight. It was found possible in this way to crash up the drums quickly and cheaply. They were then laid into cars and were eagerly sought by junk dealers. It would be a very simple matter to substitute a derrick for the railroad crane if the crane were not available.

At Stamford, Conn., a large crusher was built using 8x10 ribs to which was nailed 4-in. planking, and over the planking, boiler iron was attached. It was necessary to allow the bolts which held the boiler iron to project in order to hold the drums between the jaws. The back plate was fixed stationary and the front plate moved with a motion similar to a jaw crusher. The moving part was operated by a pitman. The pitman was operated by a large bull wheel and the crusher was so arranged that the drum could be dropped into the top as the jaw opened wide. Each time the jaw went back and forth the drum was crushed flatter until it fell out of the opening at the bottom. The wheel was driven by motor geared down to slow speed. This crusher worked very effectively for bleach cans, but I do not remember having seen heavier drums crushed in it. Of course, the heavy drums are very easily crushed if the heads are cut out with an acetylene torch.

I am sure that the plans for the Stamford crusher can be had from the Chemical Warfare Service.

O. R. SWEENEY.

Professor of Chemical Engineering,
Iowa State College,
Ames, Iowa.

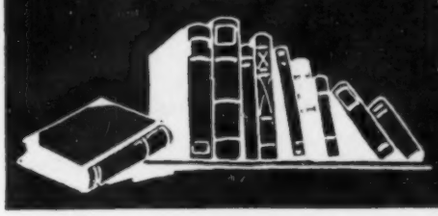
To the Editor of Chem. & Met.:

Sir:—Answering the inquiry by M. Szamatolski, in the July number of *Chem. & Met.* (p. 436) as to a way of disposing of drums and other metal containers, one large company which uses large quantities of oils, resins, and salts, has made up a small-capacity hydraulic press, operated by a 1-hp. motor, that telescopes the containers into a flat disk hardly larger than the head of the original drum, after which they are baled up and sold for scrap metal.

C. G. WILLIAMS.

Chief Engineer,
Green Bay Barker Machine & Tool Works,
Green Bay, Wis.

Chemical Engineer's Bookshelf



Placing the Chemical Plant

PLANT LOCATION. By *W. Gerald Holmes.* McGraw-Hill Book Co., Inc., New York, 1930. 265 pages. Price, $3.

Reviewed by CHARLES W. CUNO

AS STATED in his preface, "The book is the outgrowth of the author's experience in plant location in the interests of both the manufacturers and the community." As is usual with those who write from their experience, the author has refrained from riding to death theories and generalities—a common failing of academic writers who have had little practical experience. Although the book is full of figures and statistical data, the author has not seen fit to dilute his argument by a single algebraic equation, nor has he found it necessary to drag in calculus to supplement plain, ordinary thinking.

The book is divided into three parts, the first of which, Choosing the General Territory, treats of markets, raw materials, transportation facilities, freight rates, fuels and power, labor and wages, laws and taxation, and such miscellaneous factors as climate, water resources, and building costs. Markets are defined as national, regional and local. Raw materials are regarded as primary and secondary, according to their importance. Of note in his chapter on transportation facilities is the emphasis placed on the importance of waterway transportation. His analysis of freight rates, and the theory of rate-making, is a concise and classic expose of this difficult subject. His discussion of fuels and power, labor and wages, laws and taxation, will no doubt call forth comment and criticism from those radically inclined. It is, nevertheless, a sane, carefully prepared outline of facts.

In Part II, Choosing the Particular Community, the discussion of community attitude, civic aspects, government and taxes, and other civic data may well be read with considerable helpfulness by local chambers of commerce, city fathers, and all those endeavoring to boost their own community in the scramble for new industries. Between the lines the discerning may read why certain communities cannot expect to attract industries.

Part III, Choosing the Site, is entirely too short. It is to be regretted that the author has not drawn a more detailed picture, perhaps more diversified examples, showing the factors actually to be considered in selecting the best plant site among those that are available.

The book outlines admirably the problems necessary to be solved in locating a new plant or relocating an old one. Because he is not wedded to any preconceived theoretical ideas, the author has not attempted to prove his theses by any bias of presentation. It is a straightforward, readable, and comprehensive exposition of the factors that govern plant location, well worthy of a place on the desk of the plant engineer and the executive.

Hydrogen-ion Determination

THE MEASUREMENT OF HYDROGEN-ION CONCENTRATION. By *Julius Grant.* Longmans, Green & Company. New York, 1930. 159 pages. Price $3.75.

Reviewed by BEVERLY L. CLARKE

THE AUTHOR has aimed his book at "the worker in the industrial laboratory who has little or no knowledge of electrochemistry but who feels that a study of hydrogen-ion concentration is essential for his purpose." There are five parts, entitled successively: Introduction; The Electrometric Method; The Colorimetric Method; Methods and Technique Applicable to Particular Cases; Tabulated Data. Two departures from the usual mode of treatment are to be noted: the presentation of the electrometric method before the colorimetric; and the collection of nearly all numerical tables, which might properly be dispersed at pertinent points throughout the text, in an appendix.

The reviewer does not feel that this book represents a particularly noteworthy achievement. In the compass of under 200 pages it is, of course, not possible to present the whole body of the theory or practice of the subject. The writer of an abbreviated compendium such as this, assumes the responsibility of selecting the authentic high spots; and the reviewer does not feel that Dr. Grant has succeeded very well. In addition to this general criticism, a number of specific instances of mis-statement of theory were noted. On page 5, for example, we learn with some amazement that the "strength" of an acid or base may be gaged by the "heat produced on neutralization." Against this we may quote from W. Nernst ("Theoretical Chemistry," London, 1911, p. 669) that "the value of the heat of neutralization does not stand in any direct relation to the strength of the acid."

On page 18 we find activity defined as if it were activity coefficient. On the same page a short paragraph in small print is devoted to the Debye-Hückel theory; the author is so alarmed at the mathematics involved there that the only intelligence one gleans about this most important theory is that it is "very complicated." The most lamentable slip, however, occurs on page 33, where the normal electrode potential is defined as the potential assumed in a 1 *Molar* solution of its ions.

The author shows in other instances a curious unfamiliarity with the subject. Such a case occurs on page 111, where he implies that differential titration is applicable only to neutralizations. On the preceding page in discussing end-point determination by calculation of maximum dE/dv, the author naïvely states that "a little consideration will show that dE/dv rises to a maximum value at the steep portion of the curve and then descends." There seems no excuse for thus sugar-coating the simple

mathematical truth that the first differential coefficient of curves of the type of titration curves passes through infinity at the point of inflection.,

The reviewer feels that the novice in hydrogen-ion measurement would do better to "consult the exhaustive standard works on the subject" (such as that of W. M. Clark) rather than risk the confusion and false perspectives to which the present volume must surely lead.

Chemistry and the Man

STUFF. By *Paulin Beery*. D. Appleton Company, New York, 1930. 504 pages. Price, $5.

Reviewed by KATHLEEN ROBERTSON

DR. BERRY, who is assistant professor of chemistry at Pennsylvania State College, subtitles her book, "The Story of Materials in the Service of Man." Such a subtitle leaves practically nothing for the reviewer to do except to say that the reader is hurried so quickly through the history and present status of air, water, fire, weather, ice, aluminum, rubber, and almost everything else that man uses to his own advantage, that he emerges from the reading exhausted and rather unstrung. The book is popularly written, to the extent, indeed, that it may be almost too elementary for any beyond the high-school age. In fairness to the author, one must admit that her task has been difficult. She had a vast amount of material to cover, but managed her arrangement well, and writes clearly and interestingly. The reviewer only questions the advisability of trying to encompass a popular encyclopedia on the chemical industries within the limits of 495 large-type pages. The illustrations are plentiful and good.

Alchemy to Wave Mechanics

CRUCIBLES; THE LIVES AND ACHIEVEMENTS OF THE GREAT CHEMISTS.—By *Bernard Jaffe*. Simon & Schuster, New York, 1930. 378 pages. Price $5.

Reviewed by THEODORE R. OLIVE

PREVIOUSLY instructor and author in chemistry, Bernard Jaffe turned his pen to a truly remarkable work. "Crucibles," the result of his four-year labor, started on its career by winning the Francis Bacon award for the humanizing of knowledge. This reviewer ventures a prediction that in its later career it will be even more widely read than Paul de Kruif's "Microbe Hunters," one of the most successful semi-popular treatments of a scientific subject.

It is something of an accomplishment to take a field of science and sketch its high lights briefly but completely from its beginnings. It is something again to do so with such charm of expression and such appreciation for the essential romance of the subject that the reader lives, in five hours, as many centuries; talks and walks with the great exponents of the subject; and through it all is the fortunate possessor of a superior intelligence which enables him to view what he sees in its broader and uncluttered aspects.

Such is Mr. Jaffe's accomplishment for the facts, the fancies, and the men of chemistry. His attack is primarily biographical, but this is biography shorn of all petty details and clothed in such delightful language as to make the results more gripping than a novel. Chemistry is shown as the epic of many minds reaching into the infinite for universal truth, an epic of 16 periods where many lesser lights revolve about the brilliance of the one supreme intellect of each era. Trevisan, the alchemist, chasing the will-o'-the-wisp of transmutation for 70 years; Paracelsus, father of modern medicine; Beecher, inventor of the phlogiston theory; Priestley, Cavendish, Lavoisier, Dalton, Berzelius, Avogadro; Woehler, parent of organic chemistry; Mendeléeff, he of the periodic table; down to the moderns: Arrhenius, the Curies, J. J. Thomson, Moseley, and Langmuir; finally, De Broglie and his wave mechanics.

A perhaps unfortunate tendency toward superlatives injects itself into any effort to review "Crucibles." Suffice it only to add that the typographic treatment and binding are entirely worthy of the contents and go far to make it a book that engineers and scientists as well as laymen will wish to accord a place of prominence in their libraries after it has been read and read again.

Introduction to Colloids

COLLOID CHEMISTRY; PRINCIPLES AND APPLICATIONS. Third Edition. By *Jerome Alexander*. D. Van Nostrand Company, New York, 1929. 270 pages. Price, $3.

JEROME ALEXANDER'S clear and interesting little book on colloid chemistry has run into a third edition, and has emerged considerably enlarged—by a third, in fact. The first and second editions, appearing in 1918 and 1924, brought the reader up to date in as simple and non-technical manner as possible. The third edition accomplishes the same result: much of the second edition is retained practically without change, but even more has been revised and enlarged and several totally new sections have been added.

Comparison of the contents-page headings hardly reveals the thorough revision the book has undergone. The chapters on fundamentals have been increased by 18 pages; those on applications by 24 pages. A brief new laboratory manual, simple enough for the intelligent layman to follow in his own kitchen, has been added. Sections such as those on isotopes, homogeneity, the colloid mill, ultrafiltration, astronomy, geology, and agriculture have been enlarged considerably. New sections are devoted to critical velocity, surface tension and the physico-chemical aspects of life, mutation, and evolution.

All in all, "Colloid Chemistry" is as interesting and readable an exposition as one could hope to find. It is the colloid chemistry of every-day life as well as of the laboratory, dressed in language that stirs the imagination and sticks in the memory.

Chemical Lexicography

THE CONDENSED CHEMICAL DICTIONARY. Second Edition; revised by *Thomas C. Gregory, Isabelle M. Welch*, and staff of the "Chemical Engineering Catalog." The Chemical Catalog Company, New York, 1930. 550 pages. Price, $10, buckram; $12, flexible Keratol.

Reviewed by RICHARD KOCH

DEMAND for ready-information books seems to have asserted itself so strongly in recent years that a sudden wave of dictionaries and handbooks has arisen to wash away whatever was insecurely lodged among necessities for reference. Especially is this felt among the smaller books, since the large works have generally taken care to maintain their usefulness. Even the Condensed Chemical Dictionary began to appear superannuated,

with its quaint tinge of the pharmacopoeia and the jobber's house.

Now on its reappearance, however, it aspires to be "the book universally used in the chemical engineering industries." And if one does balk at encompassing the technical universe in its 16,000 original subscribers, one can still observe with admiration that its new contents are really in agreement with a mature industry, grown up in these eleven years. In actual size the book has decreased, but the paper, type and arrangement combine to contain a much greater volume of material. A thumb-index and expanded section of tables and regulations further adorn the new edition.

Most important is the changed occupant of the "greatly enlarged quarters." Most of the older specifications turn out to be there still; but a greater number of new available chemicals and materials, with their new uses, give the whole book a different complexion. Comparison reveals not only the revision of all details but also the valuable inclusion of such industrial subjects as nitrogen fixation, rayon, inks, chromium plating, and the like, explained to some length. And there is evidence that information as late as May, 1930, has been exploited to this end. Of course, a close inspection discloses slight slips in typography and fact, but since these are an inevitable bane of publishing, their rarity in this volume is in itself commendable.

A GERMAN-ENGLISH TECHNICAL AND SCIENTIFIC DICTIONARY. By *A. Webel.* E. P. Dutton & Company, New York, 1930. 887 pages. Price, $10.50.

LIKE other recent reference works, this entirely new one displays excellence in several individual respects. In fact, even within its own territory, where it must find its scope, recommendation becomes an uncertain task that depends largely on specific requirement. Certainly none of the prior works is entirely displaced by it; but in arguing that this leaves matters still less satisfactory, one must be content to weigh the virtues of each book against one's demands. Webel's large volume does not even mention "chemical" in its title, so that it surprises by its completeness in chemical references. But other fields of science also are included, and this universality has produced one of the principal features, brevity. The customary maze of subsidiary references is replaced by several terse translations, the helpful effect of which is heightened by large type. In other words, it is refreshing and not discouraging. However, some territories seem to have suffered by its ambitions, their special terminology alone requiring a volume of this size. That this does not impair its value to the chemically trained is its great recommendation for them; they will be thankful for the additional references from other fields.

The volume also carries a long Latin scientific nomenclature, with German and English translations, as well as abbreviations and the chemical constants. A novelty is a numerical code system, collateral with the text, which is intended to facilitate business transactions by wire.

DIZIONARIO DI MERCEOLOGIA E DI CHIMICA APPLICATA. Fifth Edition. Ulrico Hoepli, Milano, 1930. 1,096 pages.

FOR American readers it will scarcely be necessary to consult this admirable work, unless a prior knowledge of Italian makes its content readily accessible. In a textual fashion it offers copious information on commercially available materials and may serve to confirm the impression that Italy's technical publications deserve notice and regard.

Electrochemistry

ELEKTROKEMI. By *Gösta Angel.* P. A. Norstedt & Söners Förlag, Stockholm, Sweden, 1930. 234 pages.

Reviewed by C. L. MANTELL

WRITTEN in Swedish, this small book follows the conventional outline of electrochemistry and contains little of unusual interest to American readers. The first part deals with the theoretical side of the subject, while the second concerns itself with the technical applications of electrochemistry. In the first section of the second part there is a good discussion of power sources for electrochemical industries. The book is not divided into chapters and in spots is disappointing. For example, 11 pages are devoted to the entire field of metallic refining, while the much less important topic of hydrochlorites and chlorates commands the same amount of space. The section on fused salt electrolysis is poorer than one has any right to expect, in that magnesium, beryllium, calcium, barium, and cerium are all discussed on one page. One is surprised to find practically no reference to pressure electrolysis of water for oxygen and hydrogen production, or other Continental electrochemical innovations. There is a total lack of literature references. Gaseous electrothermics and nitrogen fixation find no place, while the electric furnace discussion is weak. The book is so brief that the subjects touched upon are merely skimmed over. Certainly there is little inducement here for learning Swedish.

Recently Arrived

PHYSICAL CHEMISTRY OF BOILER-SCALE FORMATION. (In German). By *R. Stümper.* Ferdinand Enke Verlag, Stuttgart, Germany, 1930. 51 pages. Price, 4.80 M.—Despite its brevity, this booklet is a complete monograph on the subject, especially in its scientific aspects, and cannot be disregarded in any work beyond routine water-treatment.

ROSIN IN SYNTHETIC RESINS. By *W. B. Burnett.* Pine Institute of America, Inc., Jacksonville, Fla., 1930. 96 pages. Free on request.—Confining himself to the subject of rosin in synthetic resins, the author records the literature in form of abstracts, most of which refer to patents. It is an admirable piece of compilation, in spite of its restrictions, in a field where a clarifying hand is needed.

HANDBOOK OF CHEMISTRY AND PHYSICS. By Charles D. *Hodgman* and *Norbert A. Lange.* Chemical Rubber Publishing Company, Cleveland, Ohio, 1930. 14th Edition. 1,375 pages. Price, $5.—This admirable little book has again been expanded to the extent of several revisions and additions very welcome to the chemical engineer.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Transactions 1929. Vol. XXII. D. Van Nostrand Company, Inc., New York, 1930. 232 pages.—Papers read before the mid-year meeting in 1929, containing a symposium on solvents and lacquers and another on distillation.

PETROLEUM DEVELOPMENT AND TECHNOLOGY, 1930. Transactions of the A.I.M.E., Petroleum Division. Published by the Institute, New York, 1930. 610 pages.—Although these papers, which were presented at the three meetings of the Petroleum Division during 1930, deal principally with the problems of the oil-field, there is a small section on corrosion and a larger one on economics.

WORLD ENGINEERING CONGRESS PAPERS, Presented by members of the Institution of Chemical Engineers. Published by the Institution at London, England, 1930.—The Society thus insures publication of its members' papers read before the Congress at Tokio in 1929.

SELECTIONS FROM RECENT LITERATURE

CORROSION OF COPPER. A. Rauch and H. Kolb. *Korrosion und Metallschutz*, June; pp. 127-32. An experimental study has been made of the corrosion of copper and its alloys by brines and solutions of salts, with particular reference to corrosion of piping systems in the potash industry. It was found that in potassium chloride brines the attack increases with concentration to a maximum at about 15 per cent KCl in drip tests, at 15 to 20 per cent when the brine was stirred in the metal, and variably between 15 and 25 per cent in a flowing brine current. The temperature effect is about what would be expected as a result of increase of rate of reaction with temperature, but is complicated somewhat by the electrolytic behavior of the metal under test. The experimental results are presented in tables and curve charts, and drawings of the test apparatus are shown. The study included both laboratory and semi-works scale trials. On account of the difficulty and relative inaccuracy of the weight loss method of measuring corrosion in the semi-works scale experiments, the corrosive effect was measured by analyzing the brines after their contact with the metal.

FILTER CLOTH LIFE. M. Werner. *Chemische Fabrik*, July 16; pp. 277-9. The durability of nitrated filter fabrics is notably greater than that of the untreated twill, in spite of the fact that nitration decreases somewhat the tensile strength of the twill. Life tests have been made, for comparison of twill with nitrated twill, under conditions simulating actual filtration service in sulphuric-acid and in hydrochloric-acid liquors. Loss in tensile strength was taken as the measure of deterioration, and curves were plotted on the basis of the time taken for loss of half the initial tensile strength. The influence of acid concentration and temperature was measured. The nitrated twill showed longer life with respect to both of these variables than did the untreated twill. Increase in either concentration or temperature decreased the half life period. Hydrochloric is more destructive to the fabrics than sulphuric acid. Based on the experimental data for both kinds of filter cloth, practical limitations are stated in the field of usefulness of nitrated and untreated twill with respect to liquors containing these two acids. Curve charts and tables of experimental data are also given.

CLEANING ACID TANKS. *Chemical Age*, April 12; pp. 344-5. The Factory Department of the Home Office in Great Britain has issued a memorandum (Form No. 814, obtainable for 2d. from H. M. Stationery Office, London) on cleaning and repairing oil or acid tanks or stills. The fire hazards encountered in cleaning such vessels arise from vapors of flammable liquid residues, or from hydrogen gas evolved by action of acid on the metal of the vessel. Poisoning hazards are due to presence of vapors of toxic hydrocarbons or oils, such as benzol, or sometimes of arsine, formed by reduction of arsenical impurities in stored acids. When the toxic or flammable vapors come from material which is volatile with steam, such as benzol or light oils, thorough steaming of the tank or still before entering it, and thorough ventilation during the cleaning or repairs, are the chief essentials. For less volatile materials other precautions are needed; for instance, repeated washing with water or other solvent. A standard procedure is described for use with tar stills, as agreed upon by the Home Office, Group V of the Association of British Chemical Manufacturers, and the Association of Tar Distillers. The method is for stills while hot from a charge; cleaning of cold stills is not recommended, but a method is prescribed which is to be followed in case a charge cannot be run preparatory to cleaning. Procedures are also described for cleaning tank cars, acid storage tanks, and smaller vessels (barrels and drums) which are not entered.

EMULSIFICATION. R. M. Woodman. *Journal of the Society of Chemical Industry*, April 18; pp. 193-7T. Emulsifiers for making up spray fluids must promote and maintain stable oil-in-water emulsions, which will not expose the sprayed plant to the phytocidal effects of the oil; they must not be sensitive to hardness of water, since sprayers often have no available supply of soft water; and the cost of the emulsifier must be reasonable. Since some of the emulsifiers which are preferable for other reasons are sensitive to hard water (e. g., soaps, resinates, and sulphonated oils), they must be used in quantities sufficient to soften a moderately hard water and to overcome the phase reversion tendency of the calcium and magnesium soaps or resinates, which favor water-in-oil rather than oil-in-water emulsions. A comparison is made of egg powder, fresh egg, caseinates, saponin, gelatin, sodium chlorate, soluble starch, and perminal as emulsifiers in making up stock sprays for use with hard and soft waters. Saponin is quite effective for emulsifying oil solutions of anthracene, making an actively toxic insecticidal spray. Bentonite is a useful emulsifier, but has a tendency to yield dual emulsions. Experiments indicate, however, that this objection can be overcome by using soap along with the bentonite; the resulting emulsions tend to be only of the oil-in-water type.

FORMATION OF PRECIPITATES. W. E. Gibbs. *Industrial Chemist*, July; pp. 273-6. This paper is one of the series by Gibbs on surface energy as related to chemical engineering practice. The principles governing formation of coarse and fine precipitates are discussed, starting with the changes in temperature, pressure, or composition necessary to cause a system to become supersaturated with respect to a component present in a molecularly dispersed state and which it is desired to precipitate. Precipitation occurs in at least two stages. In the primary stage numerous very small particles form, nearly simultaneously, throughout the system. In the secondary stage these particles grow by crystal growth, coalescence or flocculation. In the primary stage the particles are still of colloidal dimensions and, having very high surface energy, may react with like or different ions or molecules in their immediate environment. This complicates the picture by introducing numerous possibilities of adsorption or carrying down of impurities, and of effects of adsorbed films on the rate or character of growth of the particles. Based on these considerations, the required conditions are stated and discussed for cases in which precipitates of given characteristics are desired. Attention is called also to the possibility of forming precipitates from vapors, subject to similar considerations.

REMOTE CONTROL IN OIL REFINERIES. Luis de Florez. *General Electric Review*, July; pp. 378-83. Increasing use of accurate control devices in the operation of oil stills, fractionating columns, cracking units, and the like has brought about a need for a remote-control system enabling one man to make all changes in valve settings as the instruments reveal to him the need. Only in this way could a refinery eliminate divided responsibility, which multiplies the chances of operating errors. Electric and hydraulic devices are known for remote control of valves and the like; but for the precise adjustments needed in oil refining a system was needed which would enable the operator to feel at the transmitting end the resistance to motion at the receiving end, so that he could suitably regulate the applied force. Selsyn motors have been applied to this type of remote control, and have been adapted to a number of specific uses in refinery practice. Drawings and photographs are shown of Selsyn equipment, both at the transmitting and receiving ends, for controlling pressure between tower and condenser in cracking apparatus; for adjusting quality of cuts in a large fractionating tower; for holding level in a fractionating tower; and for controlling pump speeds by actuating the governor mechanism. As a new de-

velopment, it is anticipated that other adaptations to specific uses in the processing industries will be rapidly forthcoming.

SAPONIFYING FATS. Kyosuke Nishizawa and Yasuo Matuki. *Journal of the Society of Chemical Industry (Japan)*, May; pp. 179-84B. A study has been made of the effects on saponification by commercial reagents when acids or salts are added or other conditions are varied. Three of the leading commercial brands of Twitchell reagent were used in the experiments, and are given ratings with respect to their fat-splitting efficiency and their darkening effect on fatty acids. The common opinion that darkening of the fatty acids is due to the presence of sulphuric acid is erroneous; the color change is about the same in the presence of hydrochloric acid. As a matter of operating efficiency, it was observed that the rate of agitation has a remarkable influence on fat-splitting power; for instance, for the three reagents the effectiveness at 100 r.p.m. agitation was only 8.7, 29.8, and 43.7 per cent, as great as at 500 r.p.m. Temperature has considerable influence, but not as much as some investigators have reported. Addition of salts inhibits the hydrolysis, by reason of the salting-out effect; addition of acids increases the hydrolytic action of the reagents, by increasing the emulsifying power of the reagent, preventing salting-out, and by the hydrolytic action of the acid itself. To obtain the best effect from Twitchell reagents in fat saponification, the specifications should require that at high temperature the reagent shall not be salted out by acids below a stated concentration, and that below such concentration strong acids shall increase the emulsifying power.

SILVER REFINING. Friedrich Vogel. *Chemisch - Metallurgische Zeitschrift*, May 31 and June 7; pp. 1209-10 and 1265-6. A comparison is made of the Möbius, Balbach Thum, Siemens-Halske, and Dietzler processes of electrolytic refining of silver. In America it is customary, with the Möbius or Balbach Thum process, to use a neutral electrolyte; in German practice the electrolyte is slightly acidified, both to improve the electrochemical effect and to accelerate the chemical solution process. A numerical comparison is made of the power losses in the Siemens-Halske and Dietzler processes, in connection with copper recovery. It shows 2,577 kw.-hr. per metric ton of alloy produced in the Dietzler process, and only 989 in the Siemens-Halske process. The similarity of the processes is such that this seems to be a surprising discrepancy; but it is actually a result merely of the more favorable relations which the Siemens-Halske process maintains with respect to electrochemical equivalents. Other comparisons of the four processes are made, with respect to their operating costs and results, with attention only to differences, neglecting those aspects in which all the processes are equivalent.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from the bureau responsible for its issue.

A Study of the Properties of Texas Polyhalite Pertaining to the Extraction of Potash, by H. H. Storch and Loyal Clarke. Bureau of Mines Report of Investigations 3002; mimeographed.

Use of Ethyl Mercaptan to Detect Leaks in Natural-Gas Distribution Systems, by R. R. Sayers, and others. Bureau of Mines Report of Investigations 3007; mimeographed.

Study of the Marshall-Bird Test for Determining the Agglutinating Value of Coal, by K. A. Johnson and H. F. Yancey. Bureau of Mines Report of Investigations 3011; mimeographed.

Results of Air Repressuring and Engineering Study of Williams Pool, Putnam - Moran District, Callahan County, Texas, by H. B. Hill. Bureau of Mines Technical Paper 470; 15 cents.

Engineering Study of the Seminole Area, Seminole and Pottawatomie Counties, Oklahoma, in co-operation with the State of Oklahoma, by R. R. Brandenthaler, W. S. Morris, and C. R. Bopp. Bureau of Mines Report of Investigations 2997. Requests for this mimeographed document should be addressed to the Bureau of Mines Experiment Station at Bartlesville, Okla.

Summarized Data of Silver Production, by Charles White Merrill. Bureau of Mines Economic Paper 8; 20 cents.

Roasting of Chromite Ores to Produce Chromates—A Study of Effects of Various Reagents and Impurities on Oxidation Reactions, by H. A. Doerner. Bureau of Mines Report of Investigations 2999; mimeographed.

Effect of Sized Ore on Blast-Furnace Operation, by S. P. Kinney. Bureau of Mines Technical Paper 459; 20 cents.

Mineral production statistics for 1928 —separate pamphlets from Bureau of Mines on: Natural Gas, by G. R. Hopkins and H. Backus, 5 cents; Bauxite and Aluminum, 5 cents; and Mica, by B. H. Stoddard, 5 cents.

Influence of Washing Coal on Coke Properties and on Gas and Byproduct Yields, by A. C. Fieldner. Bureau of Mines Report of Investigations 3020; mimeographed.

Selected Bibliography and Map of Manganese Deposits of the United States by Districts, by M. V. Healey and A. L. Johns. Bureau of Mines Information Circular 6274; mimeographed.

List of Publications of the Department of Commerce. Edition of May 15, 1930. Available from Department of Commerce.

Miscellaneous Publications

Spectrum Analysis. Published by Adam Hilger, Ltd., London, England. Bulletin No. 2. 23 pages. Quantitative analysis, tables, and bibliography, and other information.

New Brunswick, Canada: Its Natural Resources and Developments. By L. O. Thomas. Department of the Interior, Ottawa, Canada. 166 pages. With its photographs, sketches, and maps, this inclusive bulletin presents a very intelligible picture of its territory. Mineral resources and their stage of development are treated in 31 pages.

American Standards Year Book 1930. American Standards Association, New York, 1930. 104 pages. Includes report of recent progress, a list of standardization projects, and an annual report.

Heat Transfer in Ammonia Condensers, Part 3. By Alonzo P. Kratz, Horace J. MacIntire, and Richard E. Gould. Bulletin No. 209, Engineering Experiment Station, University of Illinois, Urbana. 52 pages. Price 35c. Continuation of the work contained in bulletins No. 171 and 186.

Patents, Trademarks, and Copyrights: Law and Practice. By Oscar A. Geier. Fifth Edition. Richards & Geier, New York, 1930. A slight revision of the previous edition, exhausted since publication last year.

The Volatility of Motor Fuels. By George Granger Brown. Engineering research bulletin No. 14, University of Michigan, Ann Arbor, 1930. 299 pages. Price $1. This study enables determination of a fuel's volatility for any desired engine performance.

Spontaneous Heating and Ignition of Agricultural and Industrial Products. Report of Conference called by National Fire Protection Association, in co-operation with the U. S. Departments of Agriculture and Commerce, November, 1929. By C. A. Browne and David J. Price. 127 pages. Besides the usual general papers on safety, it contains reports on research and studies of the problem from specific viewpoints.

Mineral Resources of Brazil. By E. T. de Oliveira. Ministry of Agriculture, Industry, and Commerce, Rio de Janeiro, 1930. 29 pages. An English version of the mineral resources, accompanied by many maps and statistics, especially an enormous geologic map in color of Brazil.

Melting Rosin From Tank Cars With Electric Heat

By F. H. Hill
General Electric Company
Cleveland, Ohio

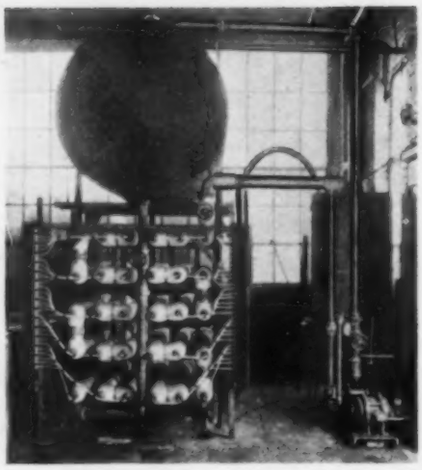
PINE ROSIN usually is shipped in barrels, the staves of which come from the same tree that gives the turpentine, after it has become useless for the latter purpose. This rosin is sold on a gross rate basis, including the barrel, at so much a pound. Where turpentine stills are located remote from a railroad, this method of shipping is economical, but where turpentine stills have a railroad siding, it would be much more economical to ship in larger bulk, eliminating the barrels, which weigh in the neighborhood of 80 lb. each and which at a pound price often cost the buyer as much as $1.25 to $2 apiece. The saving in freight also is a considerable item.

One large user of rosin recently gave consideration to shipping rosin in tank cars. A considerable saving could be made if rosin could be shipped in bulk in this way and provided it could be economically removed after reaching its destination.

The problem was given some thought, and a plan of using hot oil as a means of heat transfer was proposed. This received approval, and the General Electric Company was asked to build, at its Cleveland service shop, a special heating equipment for removing rosin from a tank car.

The accompanying illustration shows the equipment provided for heating the oil, which in turn is used for melting the rosin so it will flow from the tank car. This equipment consists of 30 lengths of 3-in. pipe connected together by return bends in which are installed 60 immersion-type oil heating units of 2½ kw. capacity, or a total of 150 kw. of electric heat. The pipes are well insulated. The tank above the heating unit is used to store hot oil and acts as an electric heat flywheel, so to speak, and as an expansion tank. The oil used is of high flash test, and is circulated through the tank, up through the heater and then to the tank car by means of a motor-driven gear pump. A bypass from the pump to the tank cuts out the tank car when it is desired to recirculate the oil in order to raise its temperature initially.

Where the pipe line leaves the heating equipment, it is wound with the capillary tube of a temperature-control instrument, which in turn automatically controls the current to the heating units, making it impossible to heat the oil above 400 deg. F.



Pipe Heater for Oil, Used to Melt Rosin From Tank Cars; Has 60 Immersion-Type Heaters and Connected Load of 150 Kw.

Rosin comes to the plant in a tank car which has been loaded directly from the turpentine still in some Southern state. The tank car is equipped inside with four 3-in. oil pipes running from end to end. These pipes are joined by headers and connected to the oil-heating equipment through valves. The same pump used in the oil-heating equipment is used for circulating the hot oil through the line in the tank car.

In an outside temperature of 20 deg. F., without blanketing the tank car or providing any shelter, it required approximately 70 hours continuous operation to melt down a tank car of rosin containing approximately 500 barrels.

There would seem to be many other applications for a compact and efficient oil heater of this type.

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Aluminum Foil Coatings Cut Evaporation Losses

IN A PAPER presented before the American Petroleum Institute at Chicago in December, 1929, Stanley Gill, of the Gulf Pipe Line Company, told of work which was under way, particularly by S. U. McGary and W. F. Rogers, of the company's research department, to determine methods for using aluminum foil as a coating material for tanks containing volatile hydrocarbons. Although experiments have not been completed, sufficient is known of the properties of such coatings to demonstrate conclusively that they possess much value for several purposes.

The most difficult feature in using aluminum foil for its protective and reflective qualities is the discovery of a suitable adhesive material that will hold it tightly to the surface of the tank to be coated. Few such adhesives have been found. The principal requirement is that the tackiness and stickiness should be of sufficient degree.

Foil of from 0.0015 to 0.005 in. thickness has been used successfully. Generally speaking, foil of less than 0.003 in. is likely to be too light if it is to be subjected to severe mechanical usage. Foil 0.003 in. thick is heavy enough for practically any application that will be encountered.

For very severe corrosive conditions, a thickness of 0.005 in. has been used. Once a suitable adhesive has been selected, application of the foil is said to be surprisingly easy. It is not damaged by rough handling and can be worked over and into irregularities of the surface with little trouble. In applying the foil, it is necessary that air bubbles be forced from under the foil. Otherwise, unsightly blisters will be formed, which, however, will not seriously interfere with the protection afforded by the coating unless they are large. Aside from simple precautions, no particular skill is required for the application of the foil. An area equal to the roof of an 80,000-bbl. tank can be covered with foil in approximately 12 man-days.

Thoroughly satisfactory coatings for tank interiors have not as yet been developed, because of the difficulty of finding an adhesive that has suitable mechanical properties and is still oilproof. Even so, in small-scale experiments in which foil coatings were applied with adhesives that were not oilproof, their life against severe sulphide corrosion was more than twice that of the best paint coatings. For exterior coatings, the foil method has worked out well for both storage tanks for petroleum products and for car tanks. The coatings are more resistant to corrosion and offer much better protection against evaporation losses than aluminum paint. Indications based on reduction of tank

vapor space temperature in comparison with aluminum painted tanks are that a tank with only the deck foil coated has an evaporation rate only about half that of a tank entirely coated with aluminum paint.

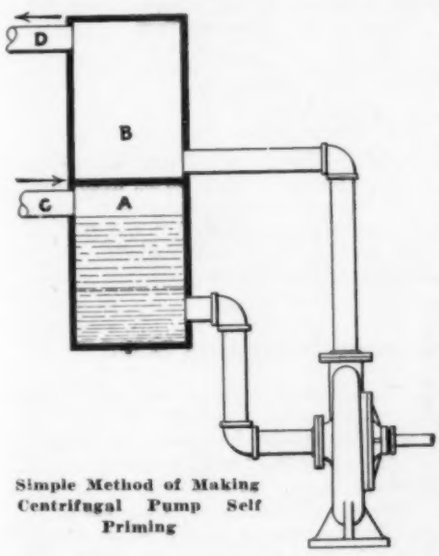
❖

Making Centrifugal Pumps Self-Priming

By W. L. Badger
and
W. L. Baker

Respectively Professor and Assistant Professor of Chemical Engineering, University of Michigan, Ann Arbor, Mich.

CENTRIFUGAL PUMPS are not normally self-priming. If they can be installed below the liquid source, or if the suction pipe be equipped with a foot valve, priming difficulties will not ordinarily be encountered, although even when so installed, the possibility of vapor locking still exists. One method not only to make any centrifugal pump self-priming but to eliminate



Simple Method of Making Centrifugal Pump Self Priming

as well any possibility of air or vapor lock, is indicated in the accompanying sketch.

The device consists essentially of two tanks, one connected into the suction and the other into the discharge line of the pump. These tanks may either be separate or, as in the drawing, made by welding a partition into a single tank to divide it into tanks, *A* and *B*. The suction line is connected at *C*, and when the system is first started, the entire tank *A* is filled with liquid. The discharge of the pump is connected to the lower part of tank *B*, and the discharge from the system is at *D*.

When the pump is started, liquid from *A* flows in and displaces any air in the pump into tank *B*. The size of the chamber, *A*, is such that the vacuum produced by this flow pulls liquid into the suction at *C*. When the pump is discharging regularly tank *B* is completely filled with liquid. When the pump is stopped, the liquid in *B* drains back through the pump into tank *A*, displacing any air in *A* back through the suction line and leaving the pump casing primed.

This system is effective only when the pump casing is so designed that all of the air in it can be displaced by liquid flowing back from tank *B*. In case there is a pocket in the top of the pump casing which cannot be so filled, this may be vented directly to the bottom of tank *B*.

Taken from the authors' book, "Elements of Chemical Engineering," shortly to be published as part of the Chemical Engineering Series by the McGraw-Hill Book Company.

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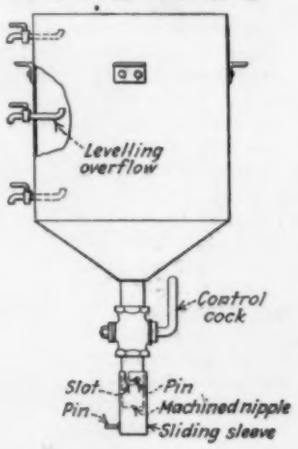
Semi-Automatic Filler for Cans and Drums

By Louis E. Brunner
Chief Chemist, Continental Chemical Corporation, Watseka, Ill.

IN MANY small chemical plants, measuring and filling methods are likely to be somewhat crude and not a little inaccurate. Any device which will eliminate, at least to a considerable extent, the human element in the measuring is likely to result in improvement. The simple filling device illustrated herewith, designed by the writer, has proved to be entirely satisfactory in this regard and the three of them now operating in our plant have given no trouble whatsoever. The sketch illustrates construction of the filler. A container, such an old 55-gal. drum, is equipped with a conical bottom and a series of drain cocks for measurement by overflowing the material to the cock level. In the tank illustrated these are for volume of 55, 30, and 15 gal. The cocks are screwed to short sections of pipe and welded into the side of the container at approximately the proper intervals for the various sizes of can or drum to be filled. Accurate adjustment of the volume at each of the cocks may be made after the filler is completed, by bending the pipes within the drum so that the turned-up inner ends are at the proper level.

A discharge pipe welded to the conical bottom carries a control cock,

Simple Semi-Automatic Filler With Overflow Cocks for Levelling



to the lower end of which is screwed a nipple machined so as to have a good sliding fit within a sleeve. A bayonet slot in the sleeve and a pin welded to the nipple support the sleeve between fillings, so that the container to be filled may be moved under the filler pipe. Then the sleeve is dropped into the container opening and supported by a second pin welded to the sleeve itself. The sleeve obviously prevents a lot of unnecessary splashing. It should be about $\frac{1}{4}$ in. smaller than the container opening to permit the escape of air.

The filler is not only accurate in its operation but it is cheap to build. It occupies little space for its installation, as it can be hung from the ceiling; and it requires no skilled operator. It is only necessary that the latter leave open the cock corresponding to the volume of liquid needed when filling the apparatus. The overflow automatically attends to the accuracy.

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Lubricating Gas Exhausters Without Oil

By W. E. Warner
London, England

INTERNAL LUBRICATION of gas exhausters often presents considerable difficulty, because of the tar and other impurities in the gas. An excellent lubricant for this purpose is a mixture of one part of refined creosote and three parts of mineral oil. Vegetable oil should not be used as the tar in the gas will cause it to thicken.

Water has been used instead of oil for lubricating and has given good results, provided that it has been pure and free from suspended matter. The water may be supplied through an ordinary drip-feed lubricator or by means of a small pump. In the case of an exhauster having a capacity of 200,000 cu.ft. of gas per day, the water fed should be from 90 to 100 drops per minute. If the exhauster has to stand idle for a considerable time, oil lubrication should be reverted to just before the exhauster is shut down.

As hard water under the action of ammonia and carbon dioxide in the gas is likely to form a deposit which will lead to trouble, ammoniacal liquor is said to be better than water, as it forms no deposit. It also has the advantage of giving the interior of the exhauster a high polish.

Some tests made on an electrically driven exhauster to show the efficiency of oil and water lubrication may be of interest:

Oil Lubrication
Power absorbed in watt-hours: 7,500 at a temperature of 30 deg. C.
Water Lubrication
Power absorbed in watt-hours: 5,000 at a temperature of 20 deg. C.

The tests were made under similar conditions, water lubrication showing a decided advantage.

EQUIPMENT NEWS
FROM MAKER AND USER

Alumina High-Temperature Insulating Material

SEVERAL YEARS of extensive research work by the Heat Insulation Fellowship maintained at Mellon Institute by the Philip Carey Company, Cincinnati, Ohio, has resulted, with the co-operation of the Aluminum Company of America, in the development of a new high-temperature alumina insulating material for temperatures in the neighborhood of 2,000 deg. F. In its production bauxite is treated chemically to produce a fluffy material, having an apparent density of approximately one-fifth that of the original bauxite. Using a binder high in alumina and silica, a block is produced consisting mainly of alumina and with no organic material.

These blocks are now being manufactured by the Philip Carey Company at a new plant in East St. Louis, Ill. Blocks are being made in a size of 9x36x2½ in. It is the intention, shortly, to produce other sizes up and including a thickness of 4½ in.

It is pointed out that the new insulation is able to withstand an abnormally high temperature by virtue of the fact that it is practically without shrinkage at a temperature of 1,950 deg. F. Most other high-temperature insulating materials are said either to shrink considerably at this temperature or to have comparatively low insulating value, and the ability of this new material to withstand such temperatures makes it suitable, according to the manufacturer, for the insulation of lehrs, kilns, high-temperature refining and process equipment, and furnaces.

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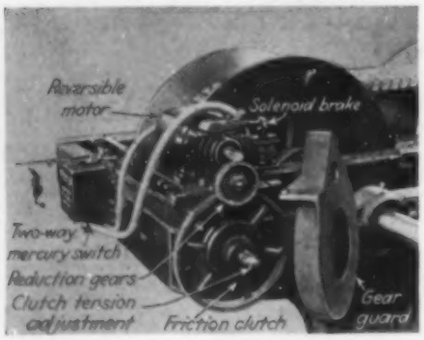
Variable-Speed Controls

AUTOMATIC CONTROL of the variable-speed transmissions of its manufacture has been announced by the Reeves Pulley Company, Columbus, Ind. It will be recalled that in this type of transmission a screw which is ordinarily operated by a handwheel, changes the relative sizes of the two pulleys, thus changing the speed ratio. In the new automatic control, this screw is operated by means of a small motor, driving through a train of gears. The motor is equipped with a solenoid brake which causes it to stop instantly when its power is disconnected. Connection is made from the gear train to the screw through a friction clutch which prevents damage in case of overshooting the end of the screw travel.

Principal Parts of New Automatic Controller for Variable Speed Transmission



The motor is controlled by means of a set of mercury switches which are in turn actuated by whatever changing function is to be used to regulate the machine speed. This may be pressure, liquid level, peripheral speed—as of a roll of material—or some other function. The motor is shut off as soon as the new adjustment of the transmission corresponds to the setting of the control switch handle. Movement of the handle in the reverse direction reverses the motor and changes the speed ratio in the opposite direction.

This control may also be provided with a remote push-button station instead of the mercury switch when it is desired to control the transmission manually from a distant point. Two push-buttons serve to operate the transmission either faster or slower.

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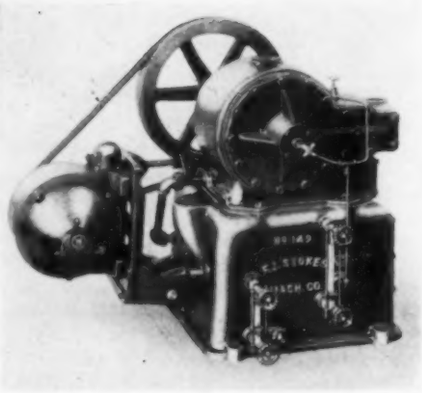
High-Vacuum Rotary Pump

FOR VACUUM DRYING, evaporating, distilling, solvent recovery, and other processes requiring high vacuum, the F. J. Stokes Machine Company, Philadelphia, Pa., has developed an oil-sealed, rotating-plunger vacuum pump, capable of drawing a vacuum of 0.01 mm. on closed systems. This is made in sizes of 10, 25, 50, 100, and 225 cu.ft. displacement per minute, the last three sizes of which are water-jacketed.

The pump consists of only three moving parts, the shaft with its eccentric, the piston with its ground hinge pin, and the suction-valve slide. All rotating and sliding parts are oil-sealed and carefully fitted, according to the manufacturer, so that there is no direct contact between the plunger and the casing and no clearance at the end of the stroke. Consequently, it is said that both the volumetric and mechanical efficiency are very high.

An oil reservoir is located in the base of the pump, supplying oil to the bearings and sealing the moving parts. An oil strainer, a condensate sump, a water gage, and drain cock on the oil reservoir



New Oil-Sealed Rotary Vacuum Pump for High Vacuum Work

and a cooling coil to reduce evaporation of any emulsified water in the oil are all special features. A baffle oil separator removes entrained oil from the exhaust. This also acts as a muffler, making the pump very quiet, according to the manufacturer. As shown in the accompanying halftone, the pump is of unit construction and includes drive equipment and direct-connected motor.

❖

Chemical Bagging Scale

FILLING BAGS to any predetermined weight is possible with a new scale which has been announced by the Toledo Scale Company, 270 Madison Ave., New York.

Special efforts have been made to prevent inaccuracy of the scale due to dust. Levers are above the floor and the supply gate, so that overflow or spillage will not fall on pivots, bearings, and levers, thus causing inaccurate weighing. Molded rubber gaskets and an oil seal prevent the entrance of dust into the dial housing. The scale is provided with a 20-in. dial and is available with a predetermined weight head for operations where it is desirable to weigh to a single mark.

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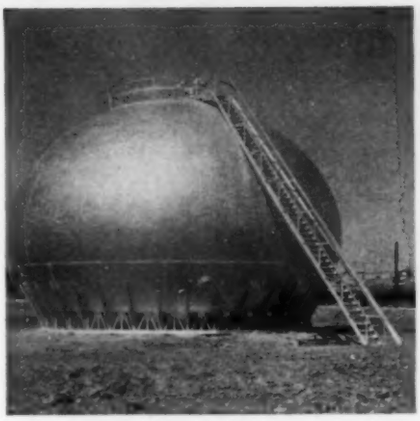
Pressure Storage Tank

IF A FLEXIBLE container, such as a rubber bag, were filled with liquid and subjected to a given pressure, the container would take a peculiar spheroidal shape such that the stresses in the container material would be a minimum. This natural form is used in the construction of the new "Hortonspheroid," which is intended for the storage of gasoline and other light products which boil at normal temperatures and are best stored under pressure.



Spheroidal Container of 10,000 Bbl. Capacity for Storage of Volatile Materials

The tank appearing in the accompanying view is one designed for the storage of natural gasoline. It has a capacity of 10,000 bbl. and is designed for a working pressure of 15 lb. Due to its peculiar construction, the minimum of steel is necessary to resist this pressure. At the same time, its working pressure of 15 lb. permits the complete elimination of standing losses when it is used for the storage of most volatile products. These tanks are available in capacities of from 2,500 to 20,000 bbl. and in working pressures of 10 and 15 lb.

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Waterproof Leather Belting

AFTER three years of testing under many conditions of actual service, Graton & Knight Company, Worcester, Mass., has announced a radically new form of leather belting, the product of a new manufacturing process known as tension cementing. According to the manufacturer, the new belt possesses superior flexibility and resistance to frictional heat and to atmospheric or other moisture, as well as higher and more uniform frictional strength. These advantages are said to be due principally to the method of fabrication and to the new type of cement used.

This cement is a sheeted pyroxylin material of high adhesive strength, waterproof character, and high heat-crystallization point. After treating with a solvent it is applied between laps and plies, under pressure and tension, by machinery especially developed by the company for the purpose. The result is said to yield resistance to the separation of the leather strips fully twice as great as with cements formerly in use. In manufacture, leather strips are lapped and cemented by machine and rolled up as single-ply rolls. To combine two plies, two rolls are placed in the tension cementing machine, where a strip of the solvent-wet cement is fed between them. Pressure is applied by rolls while other rolls maintain tension on the drying belt to insure the satisfactory performance of the cement under service conditions. Production by the machine is many times more rapid than by the old hand methods.

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Closely Adjustable Valves

CLOSE REGULATION of oil supplied to oil burners is said to be inherent in the new "Micro-Vernier" oil-regulating valve developed by the Hauck Manufacturing Company, 126 Tenth St., Brooklyn, N. Y. The valve

Vernier Valve, Screw-Operated, With Indicator

is also proposed for use with other slightly corrosive liquids which require very accurate regulation.

The halftone shows the valve to consist of a body to which is attached a fine-pitch regulating screw to control the position of the gate through an arm. The gate slides around the inside periphery of the body, uncovering a slot on the downstream side as it is turned. As the edge of the gate is notched, very fine adjustments are possible. At the same time, this feature is said to reduce greatly possibility of clogging. These valves are made of bronze in sizes from $\frac{1}{4}$ to $\frac{3}{4}$ in., and capacities from 50 to 500 gal. of oil per hour, at 60 lb. pressure.

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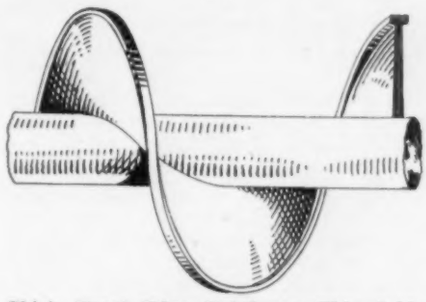


Thick Upset Edge Reinforces This Cold-Formed Spiral Conveyor

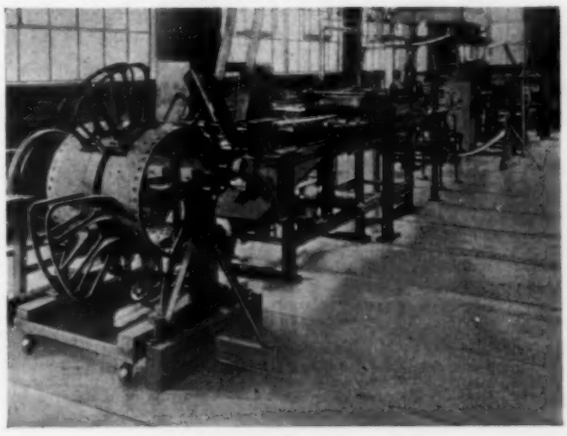
Cold-Formed Spiral Conveyor

COLD ROLLING and cold forming, said by the Bailey-Burruss Manufacturing Company, Atlanta, Ga., to be its exclusive development for the purpose, are featured in a line of continuous-flight spiral conveyors which this company has recently introduced. Without preheating, the flights are cold-rolled from bar stock, producing a product which, it is claimed, has superior uniformity, smoothness, and hardness of the outer surface. This is reported to give greater wear resistance and less friction.

The grade known as "Super Helicoid" is a standard type of spiral conveyor made by this process. A newer type, known as the "Perfecto Super Helicoid" is cold-formed with a thick upset edge for which greater strength and non-sagging properties are claimed. This is illustrated in the accompanying drawing.

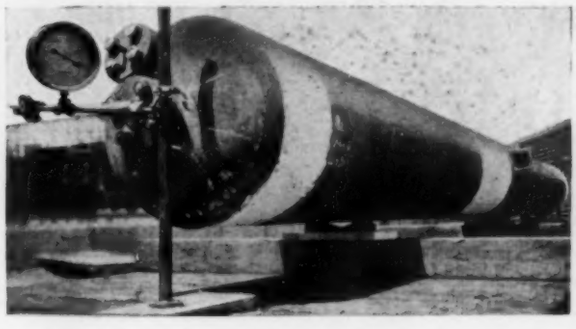
These two types of conveyor are produced in sizes from 3 to 16 in. in diameter and standard lengths varying from 8 to 12 ft., depending upon size. They may be mounted on standard or special pipe or on solid shafts.

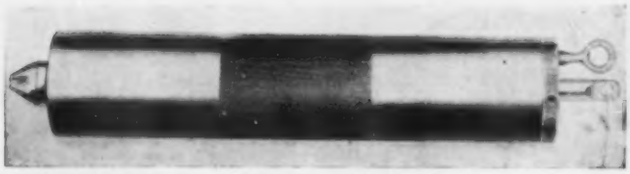
Graton & Knight Tension Cementing Machine in Operation



10,000-Lb. Test for Chrome-Vanadium Vessel

A. O. Smith Corporation, Milwaukee, Wis., recently gave a welded vessel of its manufacture what is said to be the most severe test to which a welded container has ever been subjected. This was a reaction chamber built of chrome-vanadium steel, for 5,000 lb. per square inch working pressure. Walls are 3⅛ in. thick. The vessel is 33 ft. long and 26 in. inside diameter. Test pressure was 10,000 lb. and measurements showed no set.





New Three-Level Sampler for Liquids Contained in Tanks

Liquid Sampler

OBTAINING SAMPLES of liquids from three different levels in a tank is possible with a new liquid sampler which has been developed by the Hills-McCanna Company, 2349 Nelson St., Chicago, Ill. This consists of a hollow metal cylinder 13½ in. long, made of non-sparking metal. A close-fitting piston without packing operates within the cylinder. Interchangeable nozzles for handling liquids of different viscosities are provided for the outlet at the lower end of the cylinder.

In operation, the cylinder is lowered into the tank to the lowest level. It is supported by a chain and the operator pulls upon a second chain, withdrawing the piston until a notch in the later strikes a spring ball. He then raises the cylinder to the next level, takes a second sample, and repeats the operation for the third level, thus being certain of a sample representative of the entire tank.

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Odorless Laminating Varnish

NO ODOR is detectable, according to General Plastics, Inc., North Tonawanda, N. Y., in the laminated products made from its new "Durez 285" odorless varnish, which the company has recently put upon the market. This varnish is furnished either in black or natural colors. Due to the close limits to which its viscosity range and available resin content are held, the company states that the laminated products made from it are of high and uniform quality. The resin used is one of the condensation products made by the company. The viscosity range of the varnish is from L to M on the Gardiner-Holdt scale and the material is thermosetting at a temperature of 250 deg. F.

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Twin Unit Heater

BUFFALO FORGE COMPANY, Buffalo, N. Y., has announced a new unit heater known as the 16-in. Twin "Breezo-Fin." This differs from the other heaters made by this company in that the extended-surface heating coils are twice as long as usual, mounted in a single casing, through which the air is driven by means of two fans mounted side by side. The result of this construction, it is claimed, is to make the unit quieter than single-fan heaters of equal capacity, and to give it a B.t.u. cost that is lower than comparable single-fan units. It is said to be conducive to economy, since one fan may be shut down, reducing steam consumption and temperature. Using a ⅛-hp. motor for each fan, this heater is reported to be capable of delivering up to 472,500 B.t.u. per hour.

Two Fan "Twin" Unit Heater

Manufacturers' Latest Publications

Apparatus. U. S. Stoneware Co., 50 Church St., New York—9-page reprint by F. D. Snell on the methods of generating hydrogen sulphide.

Blowers. P. H. & F. M. Roots Co., Connersville, Ind.—Bulletins 22-B2 and 23-B2—Describing respectively standard and heavy duty blowers equipped with roller bearings.

Disintegration. William Wharton, Jr. & Co., Easton, Pa.—4-page booklet describing the Vasel grinding mill for grinding pastes and colors. The mill is of the roll type and features self-contained hydraulic pressure control between rolls.

Disintegration. Whiting Corp., Harvey, Ill.—Bulletin 10—4-page folder describing a recently developed unit pulverizer, No. 3, for coal, made by this company.

Dust Handling. Allen-Sherman-Hoff Co., Philadelphia, Pa.—Catalog 730—Describes the "Hydrovac" system of soot and fly-ash handling in which dust is removed in dry condition from the dust hoppers by means of high velocity air after which it is mixed with water and discharged.

Electrical Equipment. Louis Allis Co., Milwaukee, Wis.—Bulletin 510—8 pages, describes Type J totally-enclosed, fan-cooled, squirrel-cage motors from 3 to 100 hp.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-544A, Dynamometers; GEA-579A, Automatic full-voltage controllers; GEA-585B, Switchboard recording instruments; GEA-708A, General-purpose synchronous motors; GEA-722B, Selsyns for remote signalling, control, and indication; GEA-754A, Reduced-voltage starters; GEA-771A, Automatic switching equipment; GEA-785B, Air drawing-oven; GEA-823C, Atomic hydrogen arc-welding equipment; GEA-1201, Herringbone gears; GEA-1052A, General-purpose synchronous motors; GEA-1257, Mechanical-drive turbines; GEA-1262, Hydraulic operators; GEA-1265A, Thermostat for use with industrial heating units; GEA-1266, Photo-electric relay; GEB-82, Explosion-chamber oil circuit breakers.

Electric Furnaces. Hevi-Duty Electric Co., 4100 Highland Blvd., Milwaukee, Wis.—Bulletin 630—Briefly describes new plant and production facilities for the manufacture of electric furnaces.

Equipment. The Pfaudler Co., Rochester, N. Y.—Catalog 714—20-page booklet illustrating, describing and giving dimensions of glass-lined equipment, applicable in the pharmaceutical, petroleum, rayon, sugar, cosmetic and mild chemical industries.

Equipment. F. J. Stokes Machine Co., Tabor Road, Olney P. O., Philadelphia, Pa.—16-page booklet illustrating pictorially the wide range of chemical plant apparatus made by this company.

Fatigue Testing. J. B. Hayes Machine Co., Urbana, Ill.—Bulletin 5—14 pages, describes 5 types of testing machines for determining fatigue of metals.

Gas Producers. L. J. Wing Mfg. Co., 156 West 14th St., New York—New edition of this company's booklet, "Improved Gas Producer Operation," containing information for operating men in plants using producer gas as fuel.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Bulletin 7520—12-page booklet describes and illustrates the application of the de Florez system of remote manual control of valves.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 730—Briefly describes various examples of savings made in several plants with graphic instruments.

Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Catalog 80, 28-page, 1930 catalog on resistance thermometers. Catalog No. 90, 40-page, 1930 catalog describing the "Hump" method for the heat treatment of steel.

Instruments. Taylor Instrument Cos., Rochester, N. Y.—Catalog Part 6—1930 edition of this company's catalog on instruments for use in the pulp and paper industry, 64 pages.

Materials Handling. Link-Belt Co., 300 West Pershing Rd., Chicago, Ill.—Data Book 1615—176-page book with flexible binding on belt conveying, including engineering, selection and application data.

Materials Handling. Stephens-Adamson Mfg. Co., Aurora, Ill.—Two new folders describing the standard and heavy-duty box car loaders, made by this company. The heavy-duty machine is new equipment.

Metals and Alloys. The Duriron Co., Dayton, Ohio—Bulletin 501—4-page leaflet describing the application of Durimet alloy in making fume ducts.

Molding Compounds. General Plastics, Inc., North Tonawanda, N. Y.—14-page booklet describing some of the applications of Durez molding compounds.

Power Generation. Worthington Pump & Machinery Corp., 2 Park Ave., New York.—Bulletin S-500—B2A—44-page catalog illustrating and describing vertical 4-cycle, air-injection Diesel engines.

Power Transmission. Gears & Forgings, Inc., Cleveland, Ohio.—Publications as follows: Catalog B-1, complete revision of this company's literature on planetary speed reducers; Catalog C-1, revision of literature on this company's line of worm gear reducers.

Presses. Fred S. Carver, 90 West St., New York—Folder describing a laboratory hydraulic press adaptable for all types of pressing.

Refractories. American Refractories Institute, Oliver Building, Pittsburgh, Pa.—8th edition of "Brands of Refractories," listing every known manufacturer of fire brick in the United States and Canada, together with a list of the brand names of their products. 70 pages, price 25 cents.

Refractories. North American Refractories Co., National City Bank Bldg., Cleveland, Ohio.—Folder gives location of all plants of this company and announces the company's combination with two additional concerns.

Rubber Products. American Hard Rubber Co., 11 Mercer St., New York—54-page catalog illustrating, describing and giving dimensions of rubber and rubber-lined equipment made by this company including hard rubber linings, tank cars, hard rubber and rubber-lined steel pipe, rubber-lined pumps, rubber utensils and miscellaneous hard rubber specialties.

Safety. Metropolitan Life Insurance Co., Policy Holders Service Bureau, 1 Madison Ave., New York—Industrial Safety No. 8—16-page booklet discusses methods of stimulating interest in safety through meetings.

Sewage Treatment. Filtration Equipment Corp., 350 Madison Ave., New York, N. Y.—Bulletin A—Describes in 11 pages the mechanical treatment of sewage for the removal of solids, through use of equipment supplied by this company.

Steam Generation. Combustion Engineering Corp., 200 Madison Ave., New York—Catalog EC-1—12-page catalog on the new fin-tube type economizer.

Water Softening. Crane Co., 836 So. Michigan Ave., Chicago, Ill.—Official Bulletin No. 23-a-19-O of Investigating Committees of Architects and Engineers, reporting on an investigation of Crane-Warle water softeners. Copies may also be obtained from R. M. Hooker, General Secretary of the reporting organization, 45 Vesey St., New York.

Welding. Alloy Welding Processes, Ltd., Ferry Lane Works, Forest Road, Walthamstow, London, E.17, England—Bulletin 60—8-page booklet on special welding electrodes for corrosion- and heat-resisting steels.

Welding. Lincoln Electric Company, Cleveland, Ohio—"Automatic Arc Welding by the Electronic Tornado Process," 40-page booklet completely describing and illustrating this process.

PATENTS ISSUED

July 1 to July 29, 1930

Paper, Pulp and Refractories

Process of Forming Ceramic Articles and the Like. Thomas S. Curtis, Huntington Park, Calif., assignor, by mesne assignments, to Vitrefrax Corporation, Los Angeles, Calif.—1,768,546.

Bleaching. Linn Bradley, Montclair, N. J., and Edward P. McKee, Plattsburg, N. Y., assignors to Bradley-McKeefe Corporation, New York, N. Y.—1,768,819-23.

Method of Producing Wood Pulp. George E. Rice, Brooklyn, N. Y., assignor, by direct and mesne assignments, to Conservation Corporation of America.—1,769,189.

Refractory Mixture. James M. Lambie and Donald W. Ross, Washington, Pa.—1,769,297.

Apparatus for Manufacturing Sheet Glass. Hermann Müllensiefen, Witten-Crengeldanz, Germany.—1,769,451.

Treatment of Pulp. William C. Weber, Larchmont, N. Y., assignor to the Dorr Company, New York, N. Y.—1,770,353.

Paper-Making Machinery. Gilbert J. Scofield, Albany, N. Y.—1,771,355.

Paper Product and Process of Making the Same. Emil E. Novotny, Philadelphia, Pa., assignor to John Stogdell Stokes, Huntington Valley, Pa.—1,771,138.

Process of Making Composite Glass. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company.—1,771,416-7.

Absorption Glass. Frederick Geistharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company.—1,771,435.

Fourdrinier Machine. John Warren Vedder, Frederick W. Lodding, and George Lamourex, Worcester, Mass., assignors to Rice, Barton & Fales, Inc., Worcester, Mass.—1,771,452.

Process for Digesting Fibrous Material. Sidney D. Wells, Quincy, Ill.—1,771,598.

Utilization of Waste Steam from Evaporation Apparatus in Pulp Digesting Plants. Einar Morterud, Torderod, near Moss, Norway.—1,771,810.

Glass-Working Tank. Leonard D. Soubier, Toledo, Ohio, assignor to Owens-Illinois Glass Company, Toledo, Ohio.—1,771,864.

Rubber, Rayon and Plastics

Ebonite Composition and Method of Producing the Same. Harold Gray, Akron, Ohio, assignor to B. F. Goodrich Company, New York, N. Y.—1,769,506.

Rubber Emulsion and Process of Making the Same. Samuel E. Sheppard and Leon W. Eberlin, Rochester, N. Y., assignors, by mesne assignments, to American Anode, Inc.—1,769,717.

Composition Containing Cellulose Esters. Joseph G. Davidson, Yonkers, N. Y., assignor to Carbide & Carbon Chemicals Corporation.—1,770,153.

Method of Preparing Coumaroneindene Resins. Robert W. Ostermayer, Pittsburgh, Pas., assignor to Neville Chemical Company.—1,770,281-2.

Shellaclike Product and Process of Making the Same. Arthur W. Burwell, Niagara Falls, N. Y., assignor to Alex Chemical Corporation, New York, N. Y.—1,770,875-6.

Furfural Resin Composition and Process of Making Same. Carleton Ellis, Montclair, N. J.—1,771,033.

Method of Producing Resin Esters. Alan C. Johnston, Kenvil, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,771,044.

Cellulose Solutions and Process for Their Production. Leon Lilienfeld, Vienna, Austria.—1,771,460-2.

Isolation of Benzylcellulose. Eduard Dörr, Elberfeld, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,771,529.

Waterproof Paper Products and the Like and Process of Making the Same. Albert L. Clapp, Danvers, Mass., assignor to the Flintkote Company, Boston, Mass.—1,771,744-5.

Petroleum Products and Refining

Method of and Apparatus for Cracking Petroleum Oil. John Primrose, Dongan Hills, N. Y., assignor to Power Specialty Company, New York, N. Y.—1,769,459.

Process for Recovering Natural Gasoline. Wilbur G. Laird, New York, N. Y., assignor to Heat Treating Company, New York, N. Y.—1,769,698.

Method of Producing Lubricating Oils. William T. Bryant, Houston, Texas, assignor to W. A. Williams, Houston, Texas.—1,769,766.

Process of and Apparatus for Treating Oils. William G. Leamon, Newark, Ohio.—1,769,788-95.

Process of Vulcanizing Rubber to Leather. Leon B. Conant, Cambridge, Mass., assignor, by mesne assignments, to Standard Patent Process Corporation.—1,769,943.

Process for Oil Distillation. Claude F. Tears, West New Brighton, N. Y., assignor, by mesne assignments, to the Texas Company, New York, N. Y.—1,769,972.

Process of Treating Hydrocarbons. Jacque C. Morrell, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,770,181.

Process of Refining Hydrocarbon Oils. Alexander S. Ramage, Detroit, Mich., assignor, by mesne assignments, to Gyro Process Corporation.—1,771,350.

Process and Apparatus for Vacuum Distillation. Philip Subkow, Los Angeles, Calif., assignor to Union Oil Company of California, Los Angeles, Calif.—1,771,385.

Distillation of Oil. Edward W. Isom, Scarsdale, N. Y., assignor to Sinclair Refining Company, New York, N. Y.—1,771,409.

Method and Apparatus for Distilling Oil. John C. Black, Destrehan, La.—1,771,705.

Coal and Organic Processes

Process for Wood Preservation. Victor R. Abrams, Brunswick, Ga., assignor of one-half to Adolph N. Shelander, Brunswick, Ga.—1,769,983.

Method for the Production of Organic Compounds Containing Oxygen. Georges Patart, Paris, France, assignor to Du Pont Ammonia Corporation, Wilmington, Del.—1,770,165.

Purification of Benzoic Acid and Its Derivatives. Lloyd C. Daniels, Crafton, Pa., assignor to the Selden Company, Pittsburgh, Pa.—1,770,393.

Production of Esters. Jerome Martin and Ignace J. Krchma, Terre Haute, Ind., assignors to Commercial Solvent Corporation, Terre Haute, Ind.—1,770,414.

Scouring Soap Powder. Fred P. Reinle, Oakland, Calif., assignor to West Coast Soap Company, Oakland, Calif.—1,770,429.

Condensed Aromatic Sulphonic Acids and Process of Making Same. Ian C. Somerville, Cheltenham, Pa., assignor to Röhm & Haas Company.—1,770,635.

Manufacture of Olefines. Rudolf Engelhardt, Leverkusen and Wilhelm Lommel, Wiesdorf, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,770,734.

Apparatus and Process for Distilling Carbonaceous Materials. William C. Kirkpatrick, Chicago, Ill., assignor to the Western Gas Construction Company, Fort Wayne, Ind.—1,770,984.

Coke Oven. Hugo Schröder, Essen-on-the-Ruhr, Germany.—1,770,998.

Process and Apparatus for Distillation of Bituminous Material. Heinrich Koppers, Essen-Ruhr, Germany, assignor to the Koppers Development Corporation, Pittsburgh, Pa.—1,771,048.

Method of Making Water Gas. Thomas W. Stone, Fort Wayne, Ind., assignor to the Western Gas Construction Company, Fort Wayne, Ind.—1,771,067.

Inorganic Processes

High-Acid Phosphates of Iron and Method of Making the Same. Matthew Green and Elmer M. Jones, Detroit, Mich., assignors to Parker Rust-Proof Company, Detroit, Mich.—1,769,057.

Recovery of Sulphur from Sulphides. Raymond F. Bacon, Bronxville, N. Y.—1,769,819.

Method of and Apparatus for Conducting Catalytic Exorthermic Gaseous Reactions. Roger Williams, Wilmington, Del., assignor to Du Pont Ammonia Corporation, Wilmington, Del.—1,769,873.

Production of Ammonium Sulphates. Raymond C. Benner, Bayside, and Arthur H. Henninger, Flushing, N. Y., assignors to General Chemical Company, New York, N. Y.—1,769,938.

Removal of Free Chlorine and Bromine from Fluid Mixtures. Joseph Baron Payman and Henry Alfred Piggott, Huddersfield, England, assignors to British Dyestuffs Corporation Limited, Manchester, England.—1,770,010.

Process and Apparatus for Preparing Lead Oxides. Pierre E. Haynes, East Aurora, N. Y., assignor to the Linde Air Products Company.—1,770,777.

Method of Manufacture Chemically-Pure Aluminum by Electrolysis. Karl Leo Meissner, Berlin, Germany.—1,770,940.

Process for Manufacture of Chloride of Potassium and Carbonates of Sodium and Potassium. Robert D. Pike, Piedmont, Ross Cummings, Berkeley, and Leo. V. Steck, Oakland, Calif.; said Cummings and said Steck assignors to said Pike.—1,770,995.

Ammonia Synthesis Process. Alfred T. Larson, Wilmington, Del., assignor to Du Pont Ammonia Corporation, Wilmington, Del.—1,771,130.

Method of Recovering Carbon Bisulphide. Charles J. Strosacker and James I. Jones, Midland, Mich., assignors to the Dow Chemical Company, Midland, Mich.—1,771,384.

Method of Recovering Sulphur. Raymond C. Benner, Bayside, and Alfred Paul Thompson, Jackson Heights, N. Y., assignors to General Chemical Company, New York, N. Y.—1,771,480-1.

Process for the Manufacture of Sulphuric Acid of Chemical Purity. Walter S. Allen, Flushing, N. Y., assignor to General Chemical Company, New York, N. Y.—1,771,520.

Method of Manufacturing Synthetic Chlorides. Dave Hirstel, San Francisco, Calif., assignor to Jennie Brandies, San Francisco, Calif.—1,771,628.

General Processes and Equipment

Multistage Mixing Apparatus. Henry Sanford Beers, Westport, Conn., assignor to the Turbo-Mixer Corporation, New York, N. Y.—1,768,735.

Mixing and Separating or Classifying Apparatus. Kenneth S. Valentine, Hollis, N. Y., assignor to the Turbo-Mixer Corporation, New York, N. Y.—1,768,870.

Method of and Apparatus for Filtering Viscous Material. Hugh Prentice, Pittsburgh, Pa.—1,769,388.

Crystallizer. William G. Hall, Manila, P. I., assignor of one-half to Roy C. Pitcairn, Honolulu, Territory of Hawaii.—1,769,779.

Apparatus for Lifting or Circulating Liquids. Cecil Featherstone Hammond, London, England, assignor of one-fifth to William Shackleton, London, England.—1,769,833.

Gas-Cooling Apparatus. Joseph Price, Stapleton, N. Y., assignor to Criscom-Russell Company, New York, N. Y.—1,769,963.

Apparatus for Dry Distillation. Mstislav Kulzinski, Tallinn, Esthonia, assignor to Eesti Patendi Aktsiaselts, Tallinn, Esthonia.—1,770,107.

Heat-Interchanging Apparatus. David G. Brandt, Westfield, N. J., assignor to Doherty Research Company, New York, N. Y.—1,770,375.

Grinding and Mixing Apparatus. Reginald Oswald Child, Harrow, England, assignor to D. Anderson & Sons, Ltd., London, England.—1,770,459.

Fire Extinguishing Device for Tanks and Other Receptacles Containing Inflammable Liquids. Friedrich Neumann, Berlin-Pankow, Germany, assignor to Pyrene-Minimax Corporation.—1,770,623.

Process of Purifying Gases. Edward C. Uhlig and Edward J. Murphy, Brooklyn, N. Y., assignors to the Bartlett Hayward Company, Baltimore, Md.—1,771,153.

Separation of the Constituents of Gaseous Mixtures. Claude C. Van Nuys, Cranford, and Joseph L. Schlitt, Elizabeth, N. J., assignors to Air Reduction Company, Inc., New York, N. Y.—1,771,197.

Liquid and Gas Contact Apparatus. Frederick H. Wagner, Baltimore, Md., assignor to the Bartlett Hayward Company, Baltimore, Md.—1,771,364.

Electrolytic Apparatus. William G. Allan, Toronto, Ontario, Canada, assignor by mesne assignments, to Farley G. Clark.—1,771,984.

NEWS *of the* INDUSTRY

Symposia Arranged for A.E.S. Meeting

A SYMPOSIUM on "Industrial High-Pressure Reactions" occupies a prominent place in the program arranged for the meeting of the American Chemical Society which will be held in Cincinnati, Sept. 9. Dr. Norman W. Krase, of the University of Illinois and at present a member of the editorial staff of *Chem. & Met.*, will direct the symposium.

The reports which will be presented in the Cincinnati symposium will review progress to date and the advances which are probable in many fields of pressure application. An outstanding feature of the program will deal with the hydrogenation of petroleum. This report will be made by Dr. R. T. Haslam, of New York, and will cover researches made by him and R. P. Russell for the Standard Oil Development Company. The laboratories of this company have contributed largely to the commercial application of pressure in the oil industry and have made available to the country many improvements in gasoline manufacture.

Another feature of the program will be a report from the research laboratory of the Massachusetts Institute of Technology. Dr. P. K. Frolich and D. S. Cryder will present their findings in the synthesis of new organic compounds from such relatively cheap and plentiful materials as water gas.

Developments such as the production of anhydrous ammonia from atmospheric hydrogen and water gas, and synthetic wood alcohol from water gas will be discussed by Dr. D. F. Smith, of the A. O. Smith Corporation, Milwaukee, and L. L. Hirst, of the U. S. Bureau of Mines; Dr. P. H. Emmett, of the Fixed Nitrogen Research Laboratory, Washington; Dr. B. F. Dodge, of Yale University; and W. F. Hamilton and W. O. Hebler, of the Charles Englehard Company, New York.

Dr. Homer Adkins, professor of chemical engineering in the University of Wisconsin, will read a paper on "Reactions of Ethanol." Prof. D. B. Keyes, of the University of Illinois, will present the results of researches conducted in association with Dr. S. Swann and R. D. Snow, of the university. Dr. Frolich and A. White, also of the Massachusetts Institute of Technology, will report experiments in the absorption of hydrogen and methane on charcoal at high pressure.

Dr. Krase is directing research at the University of Illinois into the fundamental properties of gases under pressure, data on which will guide the design and operation of pressure plants in many industries. "Specific Heats of Nitrogen Under High Pressure" is the title of the report which he will make on studies conducted by himself and Dr. B. H. Mackey at the university.

A symposium on industrial fermentations also has been scheduled, with Bruce K. Brown, of the Standard Oil Company of Indiana, as chairman.

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Alcohol Supervisors Hold Conference

AT THE beginning of the month, James M. Doran, commissioner of the Bureau of Industrial Alcohol, called supervisors of permits of the twelve regional districts to a two-day conference in Washington.

Commissioner Doran announced that reorganization has been perfected without any interruption of public business and that the headquarters offices of the twelve permissive districts are functioning smoothly. He said that every necessary official step had been taken to insure the expeditious handling of the public business.

While stressing the importance of checking diversions of lawfully produced liquors, Dr. Doran said: "We also have a rather difficult task to perform in seeing that the interests and activities of certain legitimate permissive classes, including professional, business, and manufacturing groups, are protected, preserved, and promoted, which is a just and proper government obligation."

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Naval Stores Research To Be Extended

EXPANSION of work on naval stores by the Forest Products Laboratory of the U. S. Forest Service, which has been so vigorously urged by naval stores industry, has been begun by the appointment of a plant chemist, J. Alfred Hall, a graduate of the University of Wisconsin, who has had eight years of varied and unusual experience in research on plant products and volatile oils. He has been chief chemist of the chemical laboratory established under the Liggett and Myers Research Fellowships at Duke University, Durham, N. C.

Barrett Anhydride Patent Upheld

UPHOLDING the decision of the federal District Court, the Circuit Court of Appeals at Philadelphia sustained the contention of the Barrett Company that it had not infringed the patent of the Selden company on a converter for phthalic anhydride. In the opinion of the judges the lower court committed no error in holding the patent valid. The judges held that while the patentee made no startling discovery in chemistry, he did produce a converter which was new and which vastly increased the ability to make phthalic anhydride.

In summing up the decision stated: "It will be seen that it required research, study, and experimentation covering a considerable period before the apparatus of the patent was finally devised. Able scientists in research laboratories were not successful in solving the problem and it is quite apparent its final solution was not due to any advances in the art, for the art made no advance, but was due to the individual labors of the patentee, who used known appliances and known principles to construct an apparatus which the old art had never used or known of."

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Technical Papers for T.A.P.P.I. Meeting

THE Erie (Pa.) members of the Technical Association of the Pulp and Paper Industry are arranging for one of the largest fall meetings in the history of the organization. The meeting will be held on Sept. 3, 4, and 5, 1930, with headquarters at the Lawrence Hotel.

It is planned to have a well-balanced technical program. Each committee is requested to sponsor one paper. Under this plan it is expected that all papers to be presented will be of outstanding merit.

There are few more accessible paper mill centers than the home of the Hammermill Paper Company. Hammermill bond papers have helped to make Erie famous. In the same city is to be found the plant of the H. F. Watson Company, which manufactures a high-grade roofing and deadening felt, insulating paper, asbestos mill board and other papers.

Nirosta Products Shown In New York

THE headquarters and display room of the Krupp Nirosta Company, Inc., in the Grand Central Terminal Building, New York City, is open now to visitors. This company controls the basic patents on the group of Nirosta alloys and this display room is maintained for the 48 American steel manufacturers now licensed to produce these materials.

The room is decorated and furnished entirely with Nirosta and contains many specimens of product fabricated from these corrosion-resistant alloys. Due to the limited space of the exhibit and wide application of these materials, the number of specimens that are directly applicable in the process industries is comparatively small; however, a careful study of the other samples demonstrates the numerous forms into which the alloys can be worked and machined, and the surface finishes that can be obtained.

Exhibits include examples of these corrosion-resistant materials in cast, rolled, drawn, spun, welded, wire, etched and riveted forms. The products range from a coil of wire having a diameter of less than half that of a human hair to a huge chemical tank for handling boiling acids. Other samples on display are corrosion-resistant seamless pipe said to be capable of withstanding the temperature and pressure generated in the cracking processes used in the manufacture of gasoline, plugs, bolts, elbows, wire screens, sinks, and piping. There is a milk can that was fabricated by drawing and welding, which is used in Germany for pasteurizing milk because of the lack of any attack on the metal. Other specimens include cooking utensils, cable, marine fittings, stranded wire, window trimming, and doors that are etched and lacquered in colors.

Some of the other industries using the material which is presented in the exhibits are pulp and paper, textile, dyeing, automotive, architectural, and aviation.

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Activated Alumina by New Process

ACTIVATED alumina, a specially prepared, partly dehydrated aluminum trihydrate in the form of hard porous masses, has been developed recently by the Aluminum Research Laboratories. Prior to the development of this new form, alumina was obtainable commercially only as a powder manufactured by the Bayer process or as a slag produced by electrothermal processes. The absorptive properties of partly dehydrated alumina in powder form have been known for many years, but because of its physical condition few, if any, commercial applications were possible.

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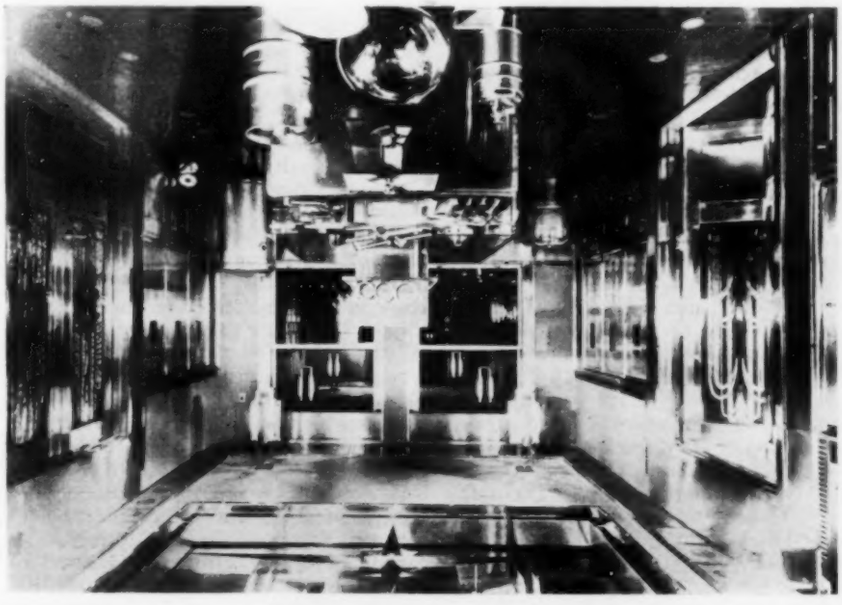
New Acetic Acid Plant Under Construction

A NEW plant which will engage in the manufacture of acetic acid and other chemicals is under construction at Crossett, Ark. The plant will be operated by the recently formed Crossett Chemical Company, of which W. H. Matthews, president of the Forest Products Chemical Company and of the Newberry Lumber & Chemical Company, will be the active head. The Suida process will be used by the company in the manufacture of acetic acid from hardwood timbers. This process was brought to the United States by Mr. Matthews. It avoids the expensive manufacture of acetate of lime as an intermediary chemical and the production cost is thus reduced.



Display Room for Nirosta Products
Floors, walls, and ceiling as well as exhibits are made from Nirosta alloys

Corrosion Theme for A.E.S. Detroit Meeting

DETROIT will entertain the members of the American Electrochemical Society on Sept. 25, 26, and 27. Headquarters for the fall meeting will be the Hotel Statler.

Corrosion will be the keynote of the meeting. Frank N. Speller, of Pittsburgh, will preside at the main scientific-technical session devoted to the cause and prevention of corrosion in the automotive industry. The various phases will be discussed, such as the advantages of rust-proof steels and other alloys, corrosion-resistant metal coatings on steel and brass, and the relative serviceability of oxide and other films produced on metals by heat-treatment or chemical processes.

A. T. Hinckley, chairman of the electrothermic division, and H. M. St. John, secretary-treasurer of the division, have arranged for an interesting round-table discussion on electric furnace gray iron. The foremost authorities will be present to submit their views and experience on this increasingly important product. The session will be entirely informal, no stenographic record will be made.

The electrodeposition division session includes a variety of papers on electroplating and among these are two detailing results on the electrodeposition of alloys. Silver, zinc, cadmium, nickel, chromium, and cobalt will be included in the program. The new chairman of the electrodeposition division is Prof. Arthur K. Graham, of the University of Pennsylvania, and the secretary-treasurer is Charles H. Eldridge, of the General Chromium Corporation of Detroit.

W. W. McCord, of the McCord Radiator & Manufacturing Company, is chairman of the local committee. Elaborate plans have been made for the entertainment of members and guests. There will be a trip to Dearborn and the Ford village. On Thursday evening there will be a theater party and dance. "A little entertainment on the Canadian shore" for Friday evening, Sept. 26 is being planned; this will be entirely informal.

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Coal Chemistry Subject Of Exhibit

CHEMICAL utilization of coal may be the subject of an exhibit under the chemistry section of the science display at the Chicago World's Fair in 1933. Such a proposal is contained in a report of the chemical division of the National Research Council Science Advisory Committee, a group of leading engineers under whose direction the chemistry exhibits at the fair will be staged.

It is proposed to show models of the various types of equipment used in the first treatment of coal such as the beehive coke oven, byproduct coke oven, and the vertical and horizontal retorts used in gas making.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

SUCCESSFUL conclusion of negotiations for a world nitrate cartel, including all the principal producers of natural and synthetic nitrogen, with the exception of American, is expected to put a stop to further development of synthetic nitrogen plants abroad. From the standpoint of the chemical industry this is regarded as more significant than the immediate objective of the agreement, which is to stabilize prices. The stabilization plan permits of greater flexibility than previous attempts on the part of foreign producers to fix prices and, in the opinion of C. C. Concannon, chief of the chemical division of the Department of Commerce, will not prevent prices from tending toward lower levels. Certainly, in view of present tremendous overproduction, no advance in prices is expected to result from the new agreement.

A collateral effect of the combination of Chilean and European producing interests is expected to be a gradual dwindling in United States imports of nitrogen as synthetic plant capacity increases in this country. Domestic production met approximately 60 per cent of domestic requirements last year and the percentage is expected to increase considerably in immediately ensuing years.

The agreement that will be referred for confirmation to the producers in the countries represented at the conference in Berlin establishes a definite price relationship between Chilean saltpeter and synthetic nitrogen for a period of one year. The Commerce Department has not received to date a detailed report of the provisions of the agreement, but it is understood that they have been drafted with a view to enabling both the European synthetic and the Chilean natural nitrate industries to carry on more profitably than in the past. This price differential scheme will permit the cartel to meet competition from nitrogen originating in outside sources. The former price fixing method concluded in June, 1929, between German, British, and Chilean groups was inflexible and permitted several outsiders to underquote the combine.

The preliminary step in the formation of the cartel embracing both the Chilean and European interests was the agreement recently concluded in Paris between the European manufacturers limiting production quotas and export sales of the individual countries. This agreement included producers in Germany, Norway, Great Britain, France, Belgium, Poland, Netherlands, Italy, and Czechoslovakia.

Although the Guggenheim interests are prominently identified with the new Chilean nitrate company, in which the Chilean government casts its lot with the private producers of nitrate of soda, the American manufacturers will not participate directly in the operation of the new combine.

NITROGEN is at present one of the most important consequential items in international affairs with one of the most recent outstanding developments in the world nitrogen industry being the formation of the Nitrate Corporation of Chile, C. C. Concannon, chief, chemical division, Department of Commerce, stated while discussing the Chilean development.

Summarizing some of the features of the law passed by the Chilean Congress establishing the Nitrate Corporation of Chile, Mr. Concannon stated that the corporation is frequently referred to as "Cosach," a term derived from the Spanish "Compania Salitrera de Chile." This is a single corporate entity set up to take the place of the many diverse interests heretofore existing. The law authorizing this project was signed July 21, 1930. Cosach will be chartered for a period of 60 years as a stock company with a capital of 3,000,000,000 pesos (approximately $365,000,000) divided into 30,000,000 shares of 100 pesos each. The Chilean government will receive 1,500,000,000 pesos nominal in non-transferable "A" shares, given in guarantee or in payment, in consideration of which it will concede to the company certain concessions including the transfer for exploitation of nitrate reserve lands estimated to contain 150,000,000 tons of nitrate. Dominion over these grounds is not given in the transfer of same. The balance of shares ("B" and preferred) will be absorbed by the present nitrate companies as and when required by the new entity.

Cosach will operate with sufficient reserves to guarantee its existence for a period of not less than 60 years; administration of production, consumption, and transportation will be unified and centralized; and eventually the industry will be completely rationalized with the reduction in the number of producing plants to six or seven modern establishments operating the Guggenheim process in place of some 60 plants now in operation using the Shanks process.

The administration will be transferred to a directorate composed of twelve members, of which four will be nominated by the President of the Chilean Republic, and seven of the common "B" stockholders, and one by the holders of preferred shares.

THE most important provision of the law, according to Mr. Concannon, is the elimination of the export duty on nitrate, in lieu of which the government will receive such dividends as might be declared to which it is entitled as a shareholder, subject however to a guaranteed revenue during the first 4 years of the company's existence. The guaranteed revenue for 1930 is placed at the equivalent of $22,500,000 and is scaled downward to $17,000,000 in 1933; the total for 4 years will aggregate $81,000,000. It is expected in Chile that the government shares of the company in its normal development will pay dividends after the fourth year in excess of the income from nitrate in years when the export tax was in effect.

A FEW chemicals now paying tariff duties may be free-listed under the provision excepting from any duty all substances used chiefly for fertilizers or chiefly as an ingredient in the manufacture of fertilizers. Inquiries have been made regarding potassium carbonate now levied at ¾c. per pound. This chemical is imported as a fertilizer for Connecticut tobacco. In order to have the free-list proviso apply, the importers must furnish conclusive proof to appraisers that this is the chief use. Theoretically, the new law might give some incentive to bring in other chemicals and develop an uneconomic use as fertilizer for half the shipment in order to evade duties and to sell the balance at a large profit.

Some concern is expressed, particularly by paper interests, over the new section which will embargo products of forced or indentured labor, effective Jan. 1, 1932. Commodities in which there is a domestic deficiency of production are excepted. If too rigidly interpreted, however, this provision could hit a wide variety of products in many countries. For example, the practice of lumber camps holding men on the job who have run up bills at the company commissary might fall within the definition.

World Nitrogen Pact Consummated

Cable advices to *Chem. & Met.* state that world producers of nitrogen have entered into an agreement and formed an organization called the Convention de L'Industrie L'Azote. It includes 98 per cent of European producers of synthetic and coke oven byproduct nitrogen, as well as Chilean nitrate interests so that 80 per cent of world nitrogen capacity is represented. The United States is the only large producer not represented. The agreement allocates national markets to domestic producers with export and import quotas regulated. A special fund has been created from which compensations will be paid to equalize quotas. The German Nitrogen Syndicate is entrusted with the management of the fund. Present curtailment of output will continue with lower prices anticipated for sulphate of ammonia and calcium cyanamid. The agreement is for a period of one year.

Larger Output of Oxidizing Agents in France

Production Shows Material Increase in Post-War Years

From Our Paris Correspondent

SINCE our last letter an International Nitrogen Congress has been held at Ostende, Belgium. The congress' objective seems to have been to see that every country should be in a position to supply its own nitrogen for home consumption. The question of exports by nitrogen-producing countries seems to have been postponed.

France is not a nitrogen-producing country—far from it—the home produced sulphate of ammonia, for instance, being insufficient to supply home needs and home-produced nitrate barely covering part of the home wants. It is believed, however, that next year the domestic supply of sulphate of ammonia will be sufficient for all home needs.

Another chemical congress also has been recently held, American delegates taking a prominent part in it. This congress discussed the world zinc output, which has risen tremendously during the last 15 years, the 1913 output being 1,000,000 tons, and the 1929 output, 1,471,500 tons. As the world's zinc consumption has not followed the world's zinc output prices have dropped accordingly. In 1929 the electrolytic zinc output was 60,000 tons higher than in 1928, so that in spite of the 16,000 tons decrease of 1929 in the thermic zinc output, sales prices for zinc still continue to drop.

The Société Electrometallurgique d'Ugine has for some time manufactured high-grade hydrogen peroxide by the sulphuric-acid electrolytic process first used in Central Europe. This process, derived from the research of the French chemist, Berthelot, uses persulphuric acid. Adequately electrolysed, the latter yields hydrogen peroxide and sulphuric acid which is again used for electrolysis. This new process has not entirely supplanted the usual manufacture of hydrogen peroxide through the decomposition of barium peroxide by phosphoric, sulphuric, or carbonic acid. The yearly output of diluted hydrogen peroxide thus manufactured is estimated to be about 10,000 tons.

SEVERAL oxidizing agents which before the world war were imported into France, such as potassium permanganate and bichromate of soda, are now manufactured in this country, the main producer of potassium permanganate being the Usines Chimiques Rhone-Poulenc. These chemical works manufacture potassium permanganate by the usual process: action of caustic alkali on dioxide of manganese yielding manganate, which, properly treated by electrolysis, yields permanganate. The potassium salt crystallizing well is the only one sold. The home production and home consumption are nearly equal, 250 tons yearly, the present price being about 10 francs a kilo.

An oxidizing agent far more commonly used is bichromate of soda, which before the war was entirely imported into France from Great Britain and Germany.

Since the war the consumption of 3,000 tons having increased to 4,500 tons, because of the frequent use of bichromate as an oxidizing agent in organic industries, the prewar imports of British and German origin still reach 3,000 tons, 2,300 tons of bichromate of soda, and 700 tons of bichromate of potassium, but the remaining 1,500 tons is made in France. Most of this 1,500 tons is manufactured by the Kuhlmann works at Loos-lès-Lille. The process used consists in roasting finely ground chrome ore, carbonate of soda and limestone; this yields chromate of soda which, under the action of sulphuric acid, yields concentrated bichromate.

The Bozel-Malétra works also manufacture bichromate by a new patent process. One of these patent processes (French Patent No. 683,190, published in July, 1930) using carbonic acid, directly turns chromate of soda into bichromate under pressure of 25 atmospheres. The latter process also yields bicarbonate which can be sold at a paying price, whereas the usual process with sulphuric acid yields only sulphate of sodium, which is almost worthless. While bichromate of soda is made in France, the potassium salt is imported, from Great Britain mostly. The uses of bichromate are numerous; it is especially used in the manufacture of colors, such as chrome yellow, which is manufactured in several works in the suburbs of Paris.

The yearly output of chrome yellows, chrome oranges, and chrome reds is about 450 tons and the yearly output of zinc chromate is 50 tons. This annual output of 500 tons of chrome colors cannot supply all the home needs, and in 1929, 120 tons of foreign chrome yellows had to be imported.

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Commercial Standards For Feldspar

COMMERCIAL standards for feldspar formulated by the joint action of producers and consumers working through the Bureau of Standards have been promulgated to take effect Sept. 1, 1930. These commercial standards classify the three groups of specifications for ground feldspar, based on particle size and chemical composition, as follows:

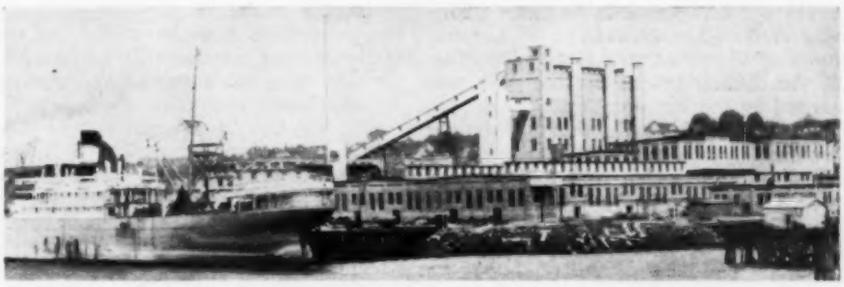
(a) Ceramic or body grades, based on silica content and alkali ration and containing less than 4 per cent soda (Na_2O) content.

(b) Spars used chiefly for glazing purposes, which are based on soda content and contain 4 per cent or more soda (Na_2O).

(c) Spars used for glass-making purposes, which are based on silica, alumina, and iron content.

The classification provides standards of fineness rated according to U. S. standard sieves with various percentages remaining on the No. 200 sieve and maximum percentages on the various coarser sizes prescribed. Sieving methods are closely defined. Chemical specifications relate to the various constituents above mentioned, for each of which analytical procedures are defined. Since practically all grinders, a substantial number of the larger distributors, and many of the important consumers of feldspar have already indicated to the Bureau of Standards their agreement with and acceptance of the standards, it is expected that they will govern substantially all commercial transactions in these materials, even before the formal effective date, Sept. 1, 1930.

New Plant of Puget Sound Pulp & Timber Company



Operation of this new 175-ton bleached sulphite mill at Everett, Wash., was started July 1. The plant represents an outlay of more than $4,000,000 and is described as one of the largest and most up-to-date plants in the United States for the manufacture of high grade bleached sulphite pulp.

Nitrogen Outlook Regarded Uncertain in England

Stocks Are Accumulating With Prices Relatively Low

From Our London Correspondent

DEPENDENT more than any other country on international trade, the present world economic situation has affected British chemical industries, but it is obvious that recovery is likely to begin here earlier than elsewhere and shrewd observers are already predicting an upward tendency. The decline in chemical exports is more apparent than real, because of the fall in wholesale prices, of which fertilizers are a typical example. The present depression has perhaps done an indirect service in drawing attention to the value of chemistry and science as the most effective weapons for combating our difficulties and for setting in motion the forces of a new prosperity.

The annual general meeting of the Society of Chemical Industry, held at Birmingham, has been given wide publicity, not only on account of the above considerations but because of the outstanding merit and real value of public utterances such as the presidential address of Dr. Herbert Levinstein, whose year of office has enhanced his already high reputation and standing.

The Messel Medal of the society was awarded to Lord Brotherton of Wakefield, in recognition of his outstanding achievement in advancing the manufacturing side of British chemical industries.

THE stock of Imperial Chemical Industries has for some time been the subject of unfavorable comment and considerable market depreciation and it was found necessary for the directors to make an official announcement in order to combat rumors and allay apprehension. The weak spots for what may well have been an organized stock market attack were probably I.C.I.'s holding in International Nickel, the present unfavorable nitrogen position, and in particular the fact that a transfer of Messrs. Brunner Mond's reserves into Imperial Chemical's balance sheet was made by the simple expedient of allowing Messrs. Brunner Mond to pay a 41¼ per cent tax-free dividend. This was erroneously considered by the uninitiated to mean that a large proportion of the trading profits for the year was earned by the Brunner Mond Company, whereas only actually that proportion certified by the auditors as profit was taken into the profit and loss account of I.C.I. as against the actual amount of $20,000,000 which was actually transferred and which was equivalent to about 60 per cent of the total trading profits.

The powers that be with I.C.I. still regard the nitrogen position with quiet confidence, partly based upon the hope that the present international conferences will have a favorable outcome. This optimism is not at present shared by others in Europe and the general outlook is in sharp contrast with the present attitude both as regards markets and expansion of production disclosed in the United States, thus reversing the position prevailing two years ago. Although stocks are accumulating, it is fairly obvious that the present low prices, which have just been confirmed for the current year, are intended mainly to act as deterrents to others, and the general tendency of technical and press utterances also is directed to that end.

TWO months ago these notes made reference to Colonel Pollitt's paper for the World Power Conference, in which he sought to show that hydrogen from coke-oven gas could not compete successfully with that from water gas. Not only has this theory been largely exploded but a week ago it was announced that the I. G. Farbenindustrie had purchased the original Mont Cenis factory for about $5,000,000, in order to supply ammonia to the I. G. Lothringen factory instead of transporting that product from the nitrogen works at Merseburg. The Mont Cenis process works at a pressure below 100 atm. and at temperatures below 400 deg. C., and development of the process in various factories both in Germany and abroad, together with the pioneer work done in the use of coke-oven hydrogen, undoubtedly upset the I.G.'s programme, and ultimately led to the understanding arrived at with the Ruhr producers. That the I.G. should pay such a price for a factory of about 30,000 tons annual nitrogen capacity, when the actual cost of installation four years ago was considerably less, not only indicates confidence in the future of the nitrogen industry but goes a long way to confirm the view that coke-oven hydrogen will continue to be used economically. The ownership of the Mont Cenis process is not, of course, transferred by the sale of the factory, so that this purchase by the I.G. was not a means of removing an unwelcome competitor.

Dr. E. F. Armstrong is the new chairman of the Association of British Chemical Manufacturers, and together with the new general manager, Davidson Pratt, is likely to stimulate renewed activity and prestige in an organization which has been somewhat overshadowed by Imperial Chemical Industries—not that I.C.I. have any special powers, but their size tends to make other firms look small when compared with them.

The Coley process for the extraction of zinc and lead from ores at subnormal temperatures and in the presence of nascent hydrogen has previously been referred to in these notes, and the annual meeting just held of the parent company, known as the N. C. Metal Company, Ltd., has thrown a little light on the present position. The recent fall in the price of zinc has been an adverse factor, particularly as regards the subsidiary, Zinc Manufacturing Company, Ltd. The first unit of plant at Messrs. Stewart & Lloyds, is at present reported to be closed down owing to the low price of zinc.

THERE has been a good deal of controversy recently about the patenting of medicinal preparations, the main point being whether it is ethical to make a profit from the alleviation of human suffering. The medical profession long ago concluded that the laborer is worthy of his hire even if he is an inventor as well as a medical practitioner, and it is being attempted to force chemical investigators and the firms employing them to adopt a more philanthropic attitude and allow their inventions to be compulsorily sequestrated. The discussion is proving of considerable interest, but the Association of British Chemical Manufacturers and the Institute of Chemistry are holding aloof until they are better able to speak unitedly on behalf of the profession.

Among recent visitors to this country and to the Society of Chemical Industry's annual meeting may be noted Dr. Ellwood Hendrick; H. E. Randall, consulting chemist from New York; Prof. and Mrs. H. R. Moody; and Dr. and Mrs. Atack, from Canada. A number of technical men from the Du Pont company also were present.

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Research Building for Hercules Powder

ON JULY 30, the Hercules Powder Company laid the cornerstone for the main building of its new experimental and research laboratories at Hercules, Del., three miles west of Wilmington. This new construction, which will cost upward of $500,000, is on a site comprising 300 acres of ground. It will largely replace the present research facilities at Kenvil, N. J.

At the cornerstone ceremonies George M. Norman, technical director of the company, introduced the president Russell H. Dunham, who, in part, stated that the importance of well-directed chemical and scientific research in that business is evident. The very products on which this business is based came originally out of the laboratory, and the important contributions that have been made in the manufacture and use of these products by the Hercules research organization are further substantial justifications for the continuance and enlargement of this phase of work.

Technical Papers Read at Meetings in Germany

Noted Chemists Discuss Alloys, Gas Technology, and Oil Hardening

From Our Berlin Correspondent

SPEAKING on the corrosion and protection of aluminum alloys, P. Brenner related his experiences before the sessions of the Deutsches Institut für Metallforschung. The thin oxide coating which is formed on aluminum and its alloys under the influence of the atmosphere, can be made into a permanent resistant coating in various ways, particularly through the anodic oxidation process in which the metal is suspended in certain electrolytes as anode and treated with a known voltage. A uniform coating is thus obtained which has the advantages over other methods, that it is electrically isolated and is densely plated. Among the various methods, the Bengough process is particularly favored, because of its corrosion resistance and durability. Practical importance is attached also to plating processes in which pure aluminum or copper-free aluminum alloys are welded on the surface of durable aluminum alloys by means of rolls. With a supplementary anode treatment, the corrosion resistance of these plated metals can be increased additionally.

At the annual meeting of the Society of Gas & Water Technologists, F. Schuster, Berlin, spoke on the alleviation of difficulties in long-distance pipe lines due to naphthalene, by means of Tetralin. The latter vaporizes at ordinary temperature and then permeates the remotest parts of the pipe system together with the gas. As a result, all naphthalene and tar deposits are washed into the water traps. The system is, therefore, also protected against corrosion, as reported in the letter for last month.

The hardening of oils by silent electric discharges—that is, the generation of the so-called "faktis"—is reported by Lothar Hock, Gieffen. Faktis is the name applied in Germany to a sort of oily caoutchouc. By thorough electrization of linseed oil—for example, by means of electric discharges—a flocculent mass with the properties of "faktis" can be produced, and subsequently isolated. The properties of the product can be improved by the addition of hydrogen sulphide in the final stages. The product is a filler comparable to "faktis" and with properties very similar in some respects to those of caoutchouc.

HIGHLY sulphonated oils, according to M. Munch, Krefeld, at the Frankfurt Chemical Meeting, can be used not only as protective colloids against the curdling of calcium and magnesium soaps, in washing and cleansing processes, but can also act similarly toward a series of other metallic soaps. An oil of this type, such as Intrasol, when added in small quantities, can prevent the precipitation in the presence of soda of basic zinc carbonate, iron carbonate, and basic copper carbonate. When sodium sulphide is added in small quantities, Intrasol causes the formation of sulphide in colloidal, filterable form, which is of value in dyeing with sulphur dyes. In undisturbed water containing iron, Intrasol prevents the formation of insoluble rust over a long period; metal soaps of zinc, iron, copper and lead also can be retained in "soluble" form. In other words, one can prevent in this way the deposit of insoluble metallic compound on textiles. By the addition of acids to the soap solution, Intrasol can prevent the precipitation of greasy or flocculent fatty acids.

A peculiar application of paper was recently put to trial at Berlin by Arthur Streich. Instead of covering certain crops with paper sheets, as is customary in America, a paper coating was sprayed on the fields. The action of paper coverings, which have been used to a rather broad extent in America, results in many cases in a greatly increased production of certain crops, because the soil temperature is increased, weeds suffocated, pests destroyed, and the soil bacteria activated. The paper spray is said to be cheap, cannot be removed by the wind, and is not dissolved by rain. What the effect on the growing plant will be, is not reported.

THE property of super-conductivity that is, the disappearance of electrical resistance at almost absolute temperature—which has been discerned for lead, mercury, tin, iridium, and thalium, has been found by Friedrich, of the Osram Company, to apply to the carbides and nitrides of heavy metals. The critical temperatures under which the resistance disappears is 9.3 deg. abs. for tantalum carbide and 10.1 deg. for niobium carbide. Hence it appears possible that compounds exist in which the critical temperatures are still higher. At present this matter is entirely of scientific interest, since it does not seem to fall within the horizon of practical utilization yet.

German imports of motor fuel increased by 65 per cent in the first five months of 1930. The automotive fuel market is, therefore, greatly exercised by the recent ordinance of the government, compelling admixture of alcohol in automotive fuels. Since it has become commercially possible to produce a technical alcohol of 99.6 per cent, this circumstance is being exploited by the authorities to increase the consumption of alcohol by enforced admixture.

To the previous remarks on the "Achema," the Chemical Exposition held in Frankfurt last month, it can now be added that its reported success has been confirmed by the numerous advance reservations that have been made for Achema VII, which is to be held in 1933.

CALENDAR

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, New Orleans, Dec. 8-10.

AMERICAN CHEMICAL SOCIETY, 80th meeting, Cincinnati, Sept. 8-12.

AMERICAN ELECTROCHEMICAL SOCIETY, fall meeting, Detroit, Sept. 25-27.

AMERICAN PETROLEUM INSTITUTE, 11th annual meeting, Chicago, Nov. 10-13.

NATIONAL METAL CONGRESS, 12th annual meeting, Chicago, Sept. 22-26.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Erie, Pa., Sept. 3-5.

German I. G. Acquires Mont-Cenis

A REPORT to the Department of Commerce says that the I. G. Farbenindustrie recently announced that it acquired the nitrogen plant of the Mont-Cenis Mining Company at Sodingen, in Westphalia. It plans to associate its production with that of the Chemische Werke Lothringen at Gerthe in Westphalia, of which the I. G. controls 50 per cent, the other half being owned by Bergbau A. G. Lothringen, of Hanover. Mont-Cenis is making in its plant No. 1 at Sodingen so-called "Montansaltpeter," an ammonium-sulphate nitrate, a material similar to "Leunasaltpeter," made by Chemische Werke Lothringen. The Mont-Cenis company is a pioneer in the field of synthesizing ammonia with hydrogen derived from coke-oven gases. It employs a synthesis with a comparatively low pressure and a strong catalyst for a higher ammonia yield than that of the Haber-Bosch synthesis. Yet the I. G., in its report on the acquisition alleges that the Mont-Cenis process is not economical now, operating alone.

The Mont-Cenis company is rated at a production now of around 50,000 to 55,000 metric tons contained nitrogen annually in its Plant No. 1, at Sodingen, and at Plant No. 2, at the Shamrock pits, formerly associated with the Hibernia (state-controlled) company, the latter based on a straight ammonium-sulphate production. The Mont-Cenis company previously controlled 51 per cent of the combination, while Hibernia had 49 per cent.

MEN
IN CHEMICAL ENGINEERING

HARRY A. CURTIS will be on leave from Yale University during the coming college year and will reside in Washington as chairman of the division of chemistry and chemical technology of the National Research Council. During Professor Curtis' absence, Prof. B. F. Dodge will serve as acting head of chemical engineering at Yale.

J. N. SELDEN, president and founder of the Selden Company, now a subsidiary of the American Cyanamid Company, has resigned and is retiring from business because of ill health.

R. NORRIS SHREVE, consulting chemical engineer of New York City, has accepted an appointment to the school of chemical engineering of Purdue University, Lafayette, Ind., where he will have charge of the work in organic technology. After graduating from Harvard University in 1907, Mr. Shreve returned to the Mallinckrodt Chemical Works in St. Louis, where he had worked previously. He was later with several firms in the East, in connection with work on organic chemicals and dyes.

Since 1919 he has carried on a consulting practice in New York. At Purdue his work, in addition to student training in industrial organic chemistry, will deal, through the Engineering Experiment Station, with industrial problems and contacts.

ROLAND P. SOULE, formerly with the International Combustion Engineering Corporation and recently with the General Oil Gas Company, will join the Tricontinental Corporation in September as technical adviser.

SPENCER W. PRENTISS has become a member of the research staff of Gustavus J. Esselen, consulting chemical engineer, Boston.

STEPHEN P. BURKE, who until recently was director of research of Combustion Utilities Corporation, New York, has become chairman of the graduate council at the University of West Virginia, Morgantown. A feature of his new position will be industrial work as the director of the industrial research division of the university.

GEORGE A. PROCHAZKA, JR., formerly general manager of the Central Dyestuffs Company and more recently engaged in consulting practice, is now with the Du Pont Ammonia Corporation, engaged in commercial research.

GUSTAV EGLOFF, of the Universal Oil Products Company, Chicago, will return to this country on the "Bremen" late this month after attending the World Power Conference at Berlin as official delegate and making a comprehensive tour of Europe as far as Constantinople.

CHARLES EDGAR MAYNARD has been promoted to factory superintendent in charge of production of the Fisk Rubber Company at Chicopee Falls, Mass. Mr. Maynard, a graduate of Amherst College in 1917, joined the Fisk company shortly thereafter and has constantly increased his duties there.

DELMER L. COTTLE has been appointed assistant professor of chemistry at Rutgers University. Dr. Cottle received his training at Marietta College, Ohio, and Ohio State.

R. A. WEAVER, president of the Ferro Enamel Corporation, has sailed for a tour of Europe, in the course of which he will visit the smelting plant of his company at Rotterdam, Holland.

FRANCIS L. SIMONS has joined the staff of Skinner & Sherman, Inc., Boston, as director of research. Dr. Simons, who studied at Brown and Yale University, was formerly with this firm.

J. ALFRED HALL has been appointed to the staff of the Forest Products Laboratory, Madison, Wis., in connection with the chemical work on naval stores. He comes from a position as chief chemist under the Liggett & Myers fellowship at Duke University, Durham, N. C.

HUGH P. BAKER, for eight years executive secretary of the American Paper and Pulp Association and subsequently manager of the trade association department of the national Chamber of Commerce, has been elected dean of the New York State College of Forestry, Syracuse University. Dr. Baker became the first dean of the New York State College in 1912 and filled this position until 1920.

OBITUARY

WILLIAM CASHMAN FERGUSON, Nov. 19, 1861 — June 3, 1930. Chemist, botanist, and profound reader, Mr. Ferguson very suddenly died at his home in Garden City, L. I., in his 69th year. Born in New York City, he started on a mercantile career there after finishing school. His nature soon rebelled against this experience and he abandoned business forever, entering Columbia University in his 22d year.

After graduation in 1887 he became analytical chemist to one of the larger sugar refineries and was dismayed to

find that the chemist could equally be a prisoner with the business man. About this time J. B. F. Herreshoff was looking for a chief chemist who could be more than an analyst and really assist him, and Ferguson, hearing of it, entered the service of G. H. Nichols & Company (later the Nichols Chemical Company), spending thereafter a lifetime in almost daily attendance at the Laurel Hill Chemical Works, Queens, New York. For 42 years Ferguson continued either as chief chemist of this company or consulting chemist to the General Chemical Company, and most of the time occupied both positions, with Dr. W. H. Nichols the financial and guiding head.

Aside from his professional work, Mr. Ferguson made botany his hobby, and for many years followed it so assiduously that he became an authority and had one of the largest private herbariums in the country. A leading botanist has said that Ferguson's plant collecting was unusually discriminating.

Meanwhile, with electrolytic copper refinery becoming a practical reality, he sustained the chemical and engineering genius of Herreshoff with an equally uncommon application of academic standards. The removal of minute quantities of impurities and exact methods for works control had to be developed before the impurities could be completely eliminated from the product. A standard of quality was thus established by Herreshoff and Ferguson that was the fruit of such a partnership and still challenges supremacy.

H. Wigglesworth

MARKET APPRAISAL OF CHEMICAL INDUSTRY

THE Libbey-Owens-Ford Glass Company reports for the quarter ended on June 30 a net income of $380,376 after all charges and reserves, including estimated federal income tax, equivalent to 21 cents a share on the 1,775,252 common shares outstanding.

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Spencer Kellogg & Sons, Inc., report for the 36 weeks ended on June 7 net profit of $429,290 after charges and federal taxes, equivalent to earnings of 78 cents a share on the common stock. This compares with a net profit of $910,195, or $1.65 a share, in the corresponding period of the previous fiscal year.

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The Glidden Company reports for June sales of $3,116,674, compared with $3,331,027 in June, 1929, a decrease of $214,353, or 6.4 per cent. For the eight months ended on June 30 sales were $25,087,109, compared with $23,321,228 in the corresponding period of the preceding fiscal year, an increase of $1,765,881, or 7.5 per cent.

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Procter & Gamble Company, excluding James S. Kirk & Company, recently acquired, reports for year ended June 30, 1930, net profit of $22,450,600. This compares with net profit in the preceding year of $19,148,933.

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The Newport Company common stockholders of record Aug. 25 are being offered the right to subscribe to additional common stock at $20 a share.

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Stockholders of the American Glue Company have approved an offer of the Carborundum Company to purchase the sandpaper and abrasive business of the company for $2,139,926 cash and also to purchase for $300,000 cash all stock of its subsidiary, Abrasives, Ltd., after the latter shall have divested itself of all of its assets not connected with the abrasives business.

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Report of U. S. Rubber Company for the six months ended June 30, 1930, shows net loss of $2,797,403 after interest, depreciation, dividends on minority stock of Dominion Rubber Company, Ltd., and foreign income taxes. This compares with net profit of $568,641 in the first six months of 1929.

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Net profit of companies in the chemical and allied industries for the first half of this year, compared with the corresponding period of 1929, show the following:

	First Half 1930	First Half 1929
Air Reduction	$2,883,845	$2,730,334
Am. Commercial Alcohol	175,931	555,657
American Maize Products	814,263	900,553
Atlantic Refining	2,819,000	8,862,409
Atlas Powder	725,023	1,194,726
Beech-nut Packing	1,438,814	1,553,242
Colgate-Palmolive-Peet	3,760,625	3,163,149
Commercial Solvents	1,497,517	1,797,924
Congoleum-Nairn	705,857	950,211
Corn Products	6,641,261	6,866,255
DuPont	32,951,314	41,538,412
Eagle-Picher Lead	836,413*	994,993
Hercules Powder	1,598,468	2,035,538
Houston Oil	1,014,417	779,432
Industrial Rayon	900,050	693,598
International Salt	322,901	231,298
Mathieson Alkali	1,107,633	1,117,371
Monsanto Chemical	622,397	.....
National Distillers	243,921	320,945
Newport Company	690,836	731,617
Phillips Petroleum	4,638,399	.....
Texas Gulf Sulphur	7,452,046	7,451,530
Union Carbide	12,779,585	14,528,243
United Piece Dye	1,911,164	1,933,029
U. S. Industrial Alcohol	522,485	1,696,051
Westvaco Chlorine	450,754	583,649

*Loss.

Price Range 1930 High	Price Range 1930 Low	Stock	Price Range in July: July 1	High	Low	July 31
34	19	Agfa Ansco Corp	....	....	....	....
156¾	103¼	Air Reduction	123¾	127¾	103¼	115
2¼	1	Ajax Rubber	1¼	1¼	1¼	1¼
343	232	Allied Chemical	262	274	240½	264
356	210	Aluminum Co	240	254½	210	....
10¼	4¼	Am. Ag. Chemical	....	7¼	4¼	....
33	9½	Am. Commercial Alcohol	9¼	14¾	9¼	12
37	17¾	American Cyanamid, B	19¼	23¼	18¼	22
7	3¼	American Hide & Leather	....	4¼	3¼	....
51¼	30¼	American Metals	34¼	34¾	31¼	....
22¼	6¼	Am. Solvents & Chemical	6¼	10¼	6¼	8¼
43¼	15¼	Anglo-Chile Nitrate	26¼	38¼	26¼	32¼
29¼	19¼	Archer-Daniels-Midland	21¼	22¼	21¼	21¼
8¼	4¼	Armour, Ill., A	5	5¼	4¼	5
51¼	30¼	Atlantic Refining	35¼	39¼	34¼	37¼
106	62	Atlas Powder	....	68	68	....
70¼	49¼	Beechnut Packing	....	56	51	55
35	28	California Petroleum	....	35	35	....
....	....	Celanese	20	....	....	....
20	13¼	Celluloid Corp	....	....	....	....
15¾	5¼	Certain-teed	6	8¼	6	8¼
32¼	20	Chickasha Cotton Oil	20	21	20	....
64¼	50	Colgate-Palmolive-Peet	51¼	59	51¼	58
199	108	Columbian Carbon	121¼	143¼	113¼	135
38	20¼	Commercial Solvents	23¼	28¼	23¼	26¼
111¼	87¼	Corn Products	92¼	99	88¼	94¼
43¼	24¼	Davison Chemical	27¼	30	26	27
42¼	21¼	Devoe & Raynolds	22	27¼	21¼	25
100	70	Dow Chemical	....	72	70	70
145¼	95¼	DuPont	103¼	118¼	95¼	115
121	114¼	DuPont, 6 pc. deb	....	118¼	116¼	....
21	5¼	Duval Texas Sulphur	....	9	7	....
255¼	175¼	Eastman Kodak	193¼	217¼	186¼	211¼
33¼	19¼	Firestone Tire	20¼	21	19¼	20¼
5¼	2	Fisk Rubber	2¼	2¼	2	2¼
55¼	37	Freeport Texas	39¼	46¼	38¼	43¼
71¼	38¼	General Asphalt	42¼	47	41¼	45¼
38	15¼	Glidden	16	18¼	15¼	17
47¼	34¼	Gold Dust	38	42¼	37¼	40¼
58¼	22¼	Goodrich Co	26	28¼	24¼	26¼
85	60	Hercules Powder	....	63	60¼	....
23	15	Heyden Chemical	....	....	....	....
116¼	52¼	Houston Oil	74¼	90¼	69	85¼
....	....	Imperial Chemical Ind	....	....	....	....
124	73	Industrial Rayon	78¼	95	78¼	....
8¼	4¼	Int. Ag. Chemical	6	6¼	5¼	....
44¼	21	International Nickel	24¼	25¼	22¼	23¼
18	9	International Paper, C	10¼	11¼	9¼	....
25	17¼	Kellogg, Spencer & Sons	18	18	17¼	....
6¼	3	Kelly-Springfield	....	4	3¼	3¼
11	4¼	Lee Rubber & Tire	....	5¼	5	....
36	22¼	Lehn & Fink	25¼	30	24¼	29¼
31¼	19¼	Libbey-Owens	20	20	19¼	....
81¼	52¼	Liquid Carbonic	67¼	72¼	64	69
37¼	18¼	McKesson & Robbins	23	24	20¼	21¼
51¼	32¼	Mathieson Alkali	37	39¼	35¼	38
63¼	35	Monsanto Chemical	37¼	46¼	37	43
39¼	24¼	Nat'l Distillers Products	28¼	29¼	26	28
189¼	125	National Lead	....	134¼	126	....
91¼	65¼	New Jersey Zinc	....	68¼	65¼	67
42	20	Newport Co	21	24	20	22¼
76¼	62¼	Ohio Oil	65¼	68¼	65	65
60¼	45¼	Owens-Ill. Glass	47	51	47	....
44¼	29¼	Phillips Petroleum	31¼	34	31¼	33
59¼	45¼	Pittsburgh Plate Glass	48	48¼	47	....
57¼	48	Pratt & Lambert	....	49¼	48	....
78¼	52¼	Procter & Gamble	70¼	75	66	73¼
27¼	19¼	Pure Oil	20¼	22¼	20¼	21¼
85	75	Sherwin-Williams	....	79¼	75	....
34¼	15¼	Silica Gel	16	20¼	15¼	....
32	20	Sinclair Oil	21¼	25¼	21¼	23¼
42	28¼	Skelly Oil	30¼	31¼	28¼	30
75	55¼	Standard Oil, Cal	59¼	63¼	59¼	62¼
84¼	58	Standard Oil, N. J	65¼	75¼	63¼	72
40¼	30	Standard Oil, N. Y	31¼	33¼	31	32
70	50	Sun Oil	....	59¼	55¼	....
10	7	Swan & Finch	....	....	....	....
34¼	28	Swift & Co	28¼	30¼	28¼	29¼
17	10¾	Tennessee Copper & Chemical	12¼	12¾	11¼	12
60¼	50¼	Texas Corporation	51¼	53¼	50¼	52¼
67¼	48¼	Texas Gulf Sulphur	52¼	60¼	51¼	58¼
17¼	10¼	Tidewater Assoc. Oil	14¼	15¼	13¼	13¼
106¼	60¼	Union Carbide	68¼	76¼	65	73¼
50	37	Union Oil, Cal	40	42	39¼	41
84	40¼	United Carbon	45¼	55¼	43¼	51
139¼	62	U. S. Industrial Alcohol	68	81	62¼	64
15¼	7¼	U. S. Leather	....	10	9¼	....
35	20	U. S. Rubber	21¼	25	20¼	21¼
97¼	76¼	Vacuum Oil	82¼	89¼	81	86
143¼	49¼	Vanadium Corp	79	106¼	75	98¼
8¼	4	Va.-Car Chemical	4¼	5	4	....
29¼	22¼	Wesson Oil	25¼	25¼	23¼	23¼
59¼	30	Westvaco Chlorine	....	45	32	45
7¼	3¼	Wilson & Co	....	4¼	4¼	....

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Increased Call for Chemicals Anticipated This Month

Consuming Industries Are Working Into More Favorable Position

WITH enlarged operations in some branches of the textile industry, increased activity in the automobile and glass trades, and more favorable reports from paint and varnish manufacturers it is anticipated that an expanding call for chemical products will be experienced during the coming month. Manufacturing operations last month did not vary much from the level of the preceding month, as gains in one direction were offset by losses in other quarters.

Latest available statistics covering operations in the chemical-producing and chemical-consuming industries prove that operating schedules for the first half of the current year were on a smaller scale than was the case during the corresponding period of last year. To a certain extent the figures show the rate of decline, but authentic data are not inclusive enough to make a general comparison anything but an approximation. Figures for production and consumption for the first six months of the year, with comparisons, are found in the accompanying table. A summary of the statistics indicates that the outlet for chemicals in the tanning, glass, pulp, fertilizer, and petroleum industries held up very well, with marked declines in the textile, rubber, and paint and varnish trades.

Domestic Production and Consumption of Specified Commodities, Jan.-June, 1929-1930

	Jan.-March	April-June	Total for 6 Months
Domestic Production			
Acetate of lime, 1929—1,000 lb.	35,793	36,709	72,502
1930—1,000 lb.	32,643	.....	50,655*
Alcohol, ethyl, 1929—1,000 proof gal.	43,970	42,470	86,440
1930—1,000 proof gal.	32,695	.....	58,161*
Arsenic, crude, 1929—ton	3,705	5,722	9,427
1930—ton	4,704	5,170	9,874
Arsenic, refined, 1929—ton	2,758	2,532	5,290
1930—ton	2,414	3,128	5,542
Automobiles			
Passenger cars, 1929—No.	1,261,185	1,502,112	2,763,297
1930—No.	868,326	1,026,680	1,895,006
Trucks, 1929—No.	185,474	266,039	451,513
1930—No.	152,318	167,701	320,019
Byproduct coke, 1929—1,000 tons	13,063	13,631	26,694
1930—1,000 tons	12,594	.....	21,106*
Explosives, 1929—1,000 lb.	103,473	107,695	211,168
1930—1,000 lb.	95,451	100,660	196,111
Glass containers, 1929—1,000 gross	7,202	7,763	14,965
1930—1,000 gross	6,937	7,580	14,517
Glass, plate, 1929—1,000 sq.ft.	35,859	37,615	73,474
1930—1,000 sq.ft.	30,238	33,129	63,367
Methanol, crude, 1929—gal.	2,111,842	2,165,832	4,277,674
1930—gal.	1,982,330	.....	3,122,513*
Methanol, refined, 1929—gal.	1,338,736	1,349,065	2,687,801
1930—gal.	1,041,846	.....	1,839,921*
Petroleum, refined, 1929—1,000 bbl.	231,564	249,279	480,843
1930—1,000 bbl.	232,830	245,616	478,446
Superphosphate, 1929—ton	960,035	865,793	1,825,828
1930—ton	1,136,722	.....	1,933,868*
Wood pulp, 1929—ton	682,054	701,036	1,383,090
1930—ton	698,982	.....	1,161,620*
Rosin, wood, 1929—bbl.	108,278	109,981	218,259
1930—bbl.	125,533	124,901	250,434
Turpentine, wood, 1929—bbl.	20,842	20,277	41,119
1930—bbl.	23,117	22,531	45,648
Pine oil, 1929—gal.	678,848	647,177	1,326,025
1930—gal.	774,398	736,107	1,510,505
Pneumatic tires, 1929—1,000	15,865	17,500	33,365
1930—1,000	11,125	.....	20,217*
Cottonseed oil, refined, 1929—1,000 lb.	500,416	202,416	702,832
1930—1,000 lb.	449,578	212,732	662,310
Cottonseed oil, crude, 1929—1,000 lb.	522,824	141,714	664,538
1930—1,000 lb.	500,558	153,012	653,570
Domestic Consumption			
Alcohol, denaturing, ethyl, withdrawn, 1929—1,000 proof gal.	38,814	38,724	77,538
1930—1,000 proof gal.	29,856	.....	51,760*
Cotton, 1929—bales	1,894,675	1,869,866	3,764,541
1930—bales	1,631,015	1,411,480	3,042,495
Silk, 1929—bales	153,455	150,480	303,935
1930—bales	158,398	111,803	270,301
Wool, 1929—1,000 lb.	150,680	142,036	292,716
1930—1,000 lb.	119,152	102,207	221,359
Fertilizers consumed in Southern states, 1929—1,000 tons	3,387	1,562	4,959
1930—1,000 tons	3,453	1,576	5,209
Cottonseed oil, refined, 1929—bbl.	867,700	891,400	1,759,100
1930—bbl.	869,300	888,600	1,757,900
Paint, varnish, and lacquer products—sales			
1929—$1,000	98,729	127,136	225,865
1930—$1,000	85,134	111,131	196,265

*Total for 5 months ended May.

A COMPARISON of export trade in chemicals and related products is not convincing, because the totals represent values without any compensation for differences in unit prices. Exports for the first half of the current year reached a valuation of $71,374,700, against $77,645,887 for the first half of 1929. Largely because of a sharp increase in shipments of benzol, coal-tar products made a better showing this year than they did in 1929.

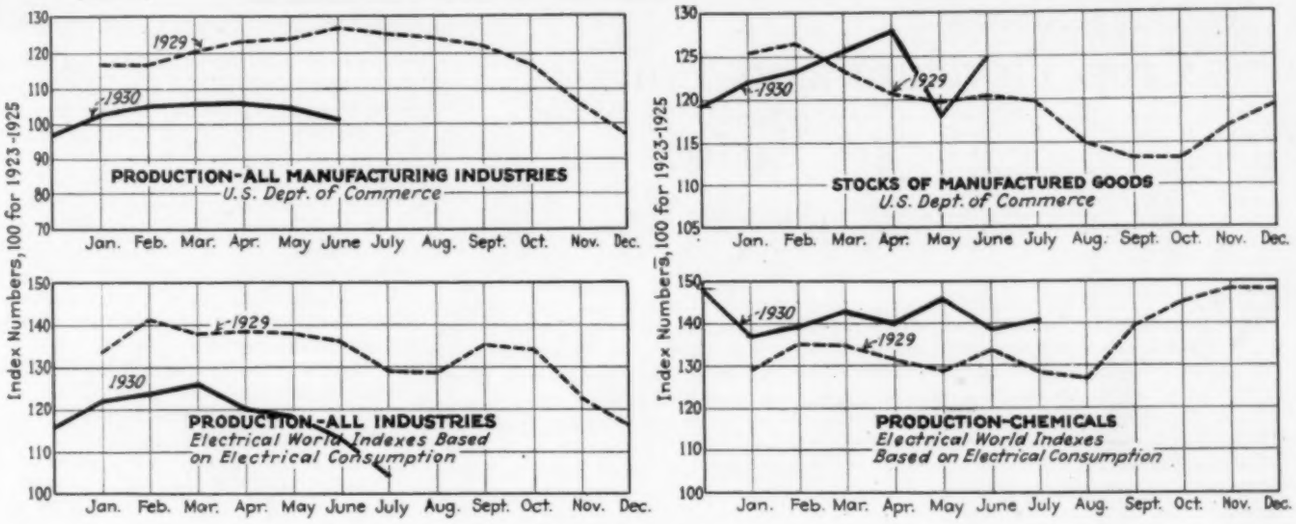
Industrial chemical specialties also gained over last year, with outward shipments of insecticides showing gains in value and even larger gains in volume. Industrial chemicals fell behind last year's totals in value, but the decline was slight if consideration is given to lower price levels. Exports of sodium compounds for the six-month period of this year amounted to 291,374,561 lb., compared with 340,761,829 lb. in the corresponding period of 1929. An increase of more than 40 per cent, however, was recorded in shipments of borax and gains also were reported for soda ash, caustic, bicarbonate, sulphate, and bichromate.

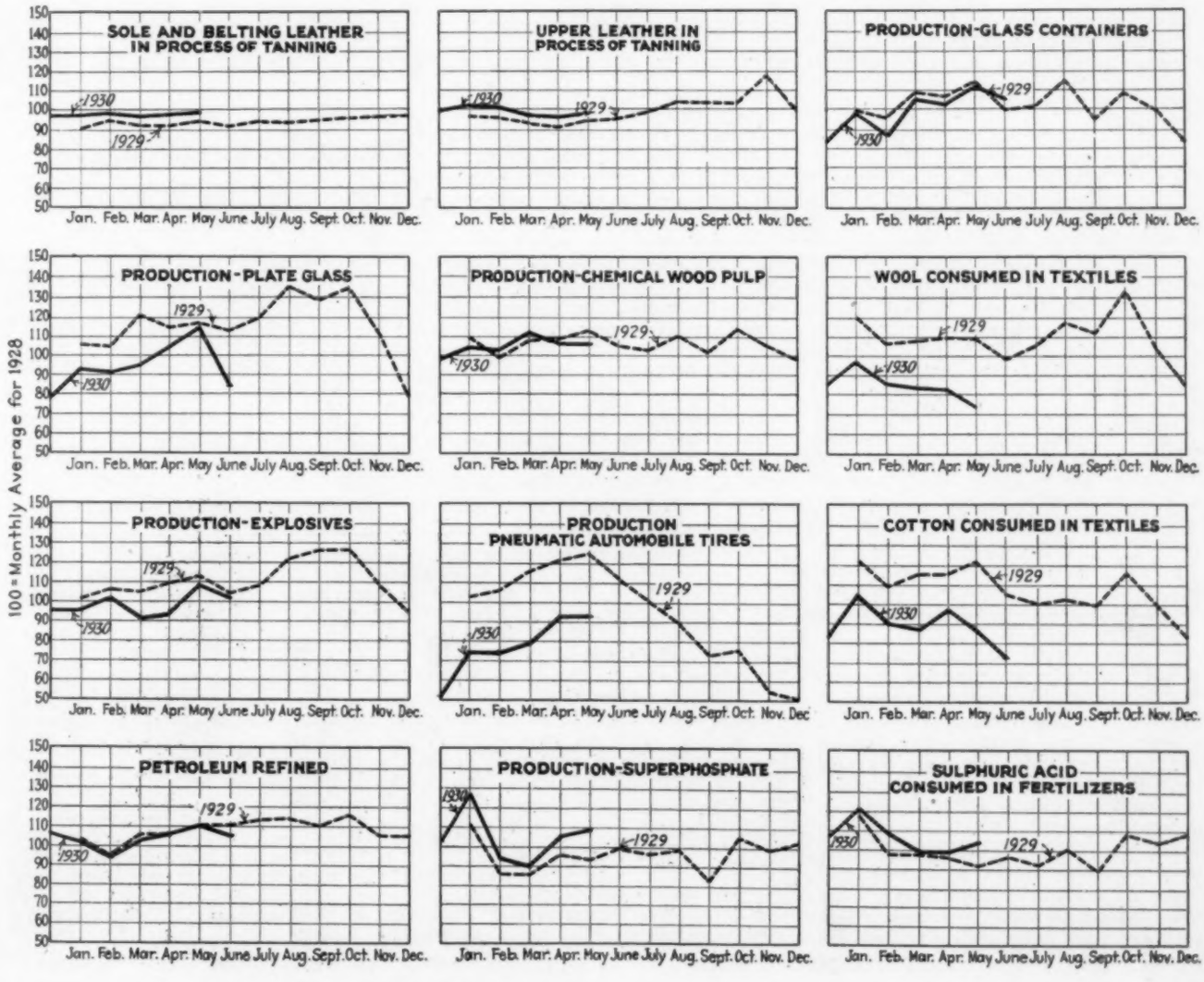
Business Sentiment Is Bullish

In its issue of Aug. 13 *The Business Week* states: "The heat wave is exerting a strong influence on the business weather. The drought, with the consequent increases in farm commodity prices, may yet turn the wholesale commodity price level upward and stimulate advance buying. . . .

"Business sentiment is bullish, though several statistical indicators continue to fall. . . . Most encouraging is a rise in commercial loans —business men are borrowing for fall activity. Though general trade continues to sag under the strain of depleted purchasing power during the past few months, increased employment in automobile and textile centers is encouraging and will be effective soon over retail counters."

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES


PRODUCTION-ALL MANUFACTURING INDUSTRIES
U.S. Dept. of Commerce
STOCKS OF MANUFACTURED GOODS
U.S. Dept. of Commerce
PRODUCTION-ALL INDUSTRIES
Electrical World Indexes Based on Electrical Consumption
PRODUCTION-CHEMICALS
Electrical World Indexes Based on Electrical Consumption
Index Numbers, 100 for 1923-1925
1929
1930
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.



MARKET CONDITIONS AND PRICE TRENDS

Crop Developments Enter as A Market Factor

Outturns of Flaxseed, Corn, and Rye Have Wide Interest

NEWS FROM agricultural sections is attracting widespread attention because on the outturns of the growing crops will largely depend future price levels for many commodities in the chemical and related fields. The severe damage incurred by the corn crop already has had some effect upon producers of industrial alcohol. One factor in this industry has expressed its intention to substitute rye for corn in the manufacture of alcohol.

The Department of Agriculture, in reporting on developments in the flax-growing states, declares that flaxseed production of about 26,000,000 bu. was indicated by Aug. 1 conditions, this being 4,000,000 bu. less than indicated on July 1. During the first week of August, however, the crop suffered further damage. Owing to the increase of 47 per cent in acreage this year, the reduced prospects are still for a crop much greater than the 16,844,000 bu. produced in 1929, though the further losses in early August probably brings the present crop prospect down close to the five-year level of 23,816,000 bu. The principal loss has been in North Dakota, where many late planted fields have not been able to survive the heat and dryness of July. The loss of flax acreage in that state, which usually produces about half of the total crop, may reach or even exceed a fourth of the total plantings.

The above indicates that the domestic supply of flaxseed will fall far short of normal requirements and the necessity for importing seed on which duty at 65c. per bushel must be paid is not relished by producing or consuming branches of the linseed oil trade.

ONE of the most important developments of the month was found in reports that shipments of sulphate of ammonia to this country from Europe had increased materially since the new tariff went into effect. Under the present ruling sulphate of ammonia is granted free entry, while it was assessed at the rate of $5 a ton under the former tariff. Surplus stocks in Europe had brought keener competition from abroad throughout the first half of this year and this condition has become intensified since June. The nitrogen situation in general would have warranted a decline in sales prices for sulphate, but foreign competition has forced an issue where the price level has become unsettled, and rumors of sales at exceptionally low prices have been current in the last few weeks.

While the position of industrial alcohol did not change materially during the month, the market appears to be steadying with some improvement in consuming demand. Competition from methanol for the anti-freeze trade is expected to become more important this year.

LOW-priced offerings of acetate of soda appear to have been cleaned up and the restrictions which now surround the sale of ethyl acetate are reported to have cut down production of acetate of soda from outside quarters so that the market is again under the control of regular producers.

Steadily declining prices for naval stores have failed to arouse buying interest and it is difficult to say whether or not the market yet has reached bottom. Receipts of gum rosin and turpentine are considerably above the totals recorded for the corresponding period of last crop year. Domestic consumption undoubtedly has fallen off this year and export trade also has been below that of a year ago. Hence the market appears to have suffered from an oversupply of stocks, but in some quarters it is held that stocks at primary points are relatively low and that offerings in the near future will not be so free.

Production of wood turpentine and rosin has been running ahead of last year's rate, with both domestic and foreign demand reported to have increased. However, one of the largest producers has announced a curtailment of output which will approximate 10 per cent, and this action is regarded as a guarantee that stocks will not accumulate unduly at producing centers.

China wood oil exports from Hankow the last month were lower than the previous month but were higher as compared with the same month of 1929. Statistics for the first seven months of this year indicate that exports were considerably higher than for the same period of last year.

	Total Exports Lb.	United States Lb.
July, 1930	13,126,000	10,398,000
June, 1930	17,778,000	14,742,000
July, 1929	11,700,320	10,616,160
Jan.-July, 1930	100,600,000	84,854,000
Jan.-July, 1929	73,035,795	64,853,625

Synthetic Resin Output Increased Last Year

PRELIMINARY figures issued by the United States Tariff Commission show a 54 per cent increase in United States production of synthetic resins together with a 50 per cent advance in the total quantities sold. Production and sales statistics for the last three years follow:

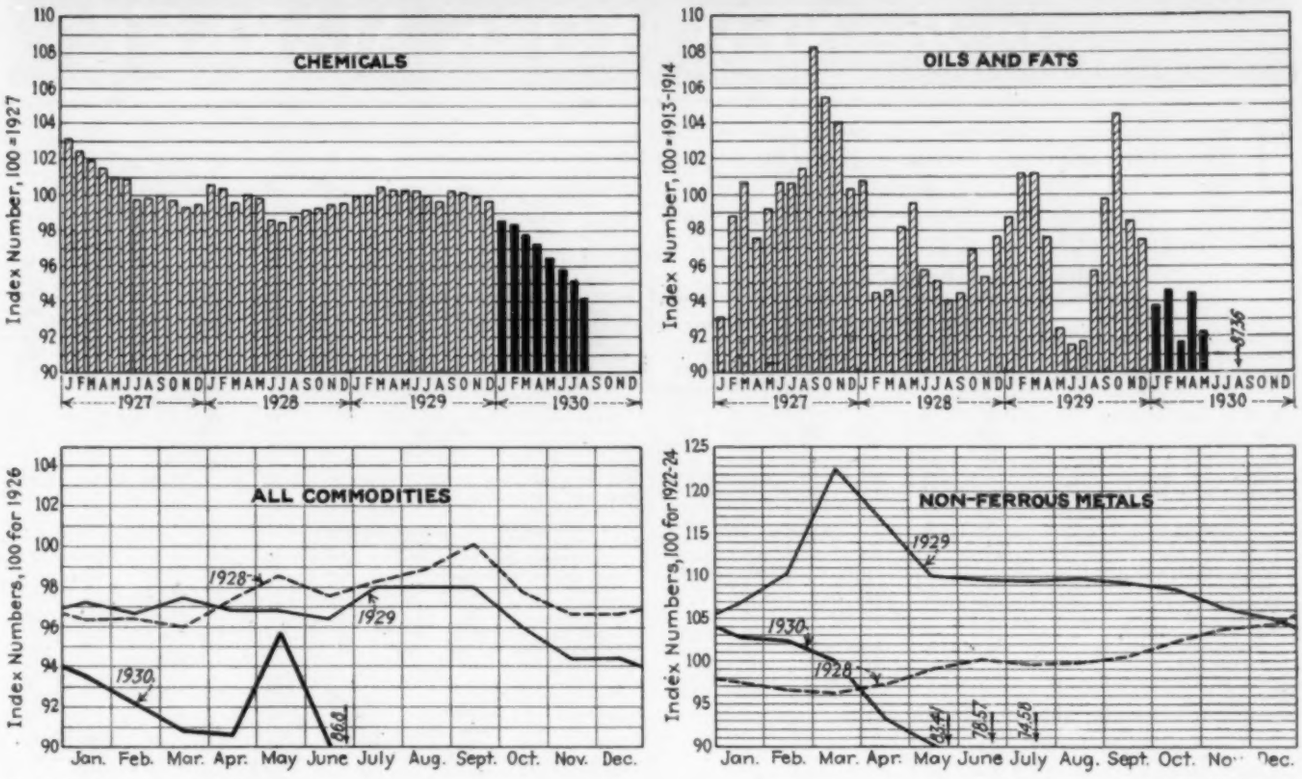
	Sales		Production
	Lb.	Value.	Lb.
1927	13,084,313	$6,094,656	13,452,230
1928	20,778,656	7,211,958	20,411,466
*1929	30,263,000	10,586,000	31,471,000

*Preliminary and subject to revision.

Factory Production and Consumption of Vegetable Oils

	Production		Consumption	
	First Half 1930 Lb.	First Half 1929 Lb.	First Half 1930 Lb.	First Half 1929 Lb.
Cottonseed, crude	653,569,868	663,938,664	737,112,571	766,906,135
Cottonseed, refined	662,309,306	703,266,023	587,339,904	607,306,021
Peanut, crude	18,525,180	6,794,072	7,641,932	7,058,971
Peanut, refined	5,357,912	5,702,732	4,648,071	4,776,647
Cocoanut, crude	169,280,867	183,168,166	327,208,160	316,400,096
Cocoanut, refined	142,032,800	157,459,431	147,921,227	146,979,031
Corn, crude	55,960,770	65,540,234	63,363,847	77,980,136
Corn, refined	47,865,301	64,141,338	8,451,419	14,997,838
Soya bean, crude	6,139,943	4,359,615	9,223,631	11,470,312
Soya bean, refined	2,443,685	4,608,873	4,723,863	2,080,167
Olive, edible	808,995	585,788	1,025,748	875,244
Olive, inedible	.....	12,925	3,619,157	2,882,227
Sulphur oil	.....	.....	20,070,439	20,874,627
Palm kernel, crude	379,403	.....	26,869,587	28,111,827
Palm kernel, refined	7,682,471	9,704,438	8,050,004	7,463,445
Rapeseed	.....	.....	5,843,516	6,747,278
Linseed	276,833,207	384,210,383	199,877,455	259,785,051
China wood	.....	.....	50,586,428	49,516,838
Castor	26,772,374	44,141,360	10,267,710	16,531,289
Palm	.....	.....	104,596,145	91,842,412
All other	6,703,396	7,286,074	12,513,811	5,903,569
Totals	2,082,663,478	2,304,920,116	2,340,962,625	2,445,489,171

CHEM. & MET. *Weighted Indexes of* PRICES


CHEMICALS
Index Number, 100 = 1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929
1930
OILS AND FATS
Index Number, 100 = 1913-1914
87.36
ALL COMMODITIES
Index Numbers, 100 for 1926
1928
1929
1930
92.68
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
NON-FERROUS METALS
Index Numbers, 100 for 1922-24
1929
1930
1928
63.41
78.57
74.58
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

U. S. Department of Labor — *Engineering & Mining Journal*

Chemical Prices Regarded as Close to Bottom

WHILE the price movement in the market for chemicals during the past month was again downward, the belief is growing that values are about at the low point. It is pointed out that seasonal influences in the near future should work in favor of more active trading, and this, combined with the fact that stocks in consumers' hands are admitted to be low, should act as a stabilizer of values.

Moreover, current quotations are on a level where profit margins are not much in excess of producing costs. Hence the removal of selling pressure, which might be expected to follow increased buying interest, likewise should eliminate much price-cutting competition.

Briefly summed up, present price levels are as low as sound merchandising will permit, and general conditions point to a larger consuming demand, which will improve the position of producers.

Weather conditions, especially the severe drought experienced in some of the agricultural sections, have been dissected as a factor on values, but, outside of a possible lowering in purchasing power on the part of fertilizer buyers, they are not regarded as important.

Metal salts fluctuate largely in unison with the basic metals, and with production of important metals showing curtailment, the outlook for changes in the price position of the salts is in favor of higher levels. Lead oxides moved upward during the month as a result of higher prices for lead.

Denatured alcohol has passed through the greater part of its slow season, and, while the market has been none too steady in recent weeks, it is probable that conditions soon will change for the better.

The international agreement among producers of nitrogen should have no immediate effect upon quotations for nitrogen products, but it should do much to hold production within bounds, and, with competition pretty well eliminated, in the long run the agreement should become a steadying force in the world's markets.

Animal fats have shown a tendency toward price recovery and sales have been made above the quotations in effect a month ago. Cottonseed oil is surrounded with some uncertainty, as new-crop oil should be available in a large way, judging from present estimates of the cotton crop.

Linseed oil is too dependent upon the outcome of the present crop to be clearly defined, but a fairly heavy early marketing of seed is expected and no important changes in the oil market should take place until a good part of the seed production has passed out of the hands of producers.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**94.15**
Last month	95.15
August, 1929	99.75
August, 1928	98.84

Alcohols were under pressure and lower quotations were in effect for acetic acid, ethyl acetate, sulphate of ammonia, salt cake, and spirits of turpentine. Tartaric acid and copper sulphate also were held at reduced levels.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**87.36**
Last month	88.28
August, 1929	95.74
August, 1928	94.07

Crude cottonseed oil varied in price during the month but was lower than in the preceding period. Crude menhaden oil declined under larger offerings. Tallow and other animal fats were firmer. Glycerine was easy, with fractional declines in price.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to August 14.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.11 -$0.12	$0.11 -$0.12	$0.14 -$0.15
Acid, acetic, 28%, bbl., cwt.	3.11 - 3.26	3.11 - 3.26	3.88 - 4.03
Glacial 99%, tanks	10 76	----	----
drs.	11.01 -11.26	----	----
U. S. P. reagent, c'bys.	12.51 -12.76	----	----
Boric, bbl, lb.	.06½- .07	.06¾- .07	.06½- .07
Citric, kegs, lb.	.46 - .47	.46 - .47	.46 - .47
Formic, bbl, lb.	.10 - .11	.10 - .11	.10½- .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18°, tanks, cwt.	1.00 - 1.10½	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 - ----	18.00- 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .11½
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl., lb.	.34 - .36	.34½- .36	.38 - .39
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl., gal.	2.63 - ----	2.63 - 2.71	2.68½- 2.71
Alcohol, Butyl, tanks, lb.	.16½- .17	.16½- .17	.16½- .17
Alcohol, Amyl	----	----	----
From Pentane, tanks, lb.	.236- ----	.236- ----	----
Denatured, 188 proof			
No. 1 special dr., gal.	.39 - ----	.42 - ----	.50 - ----
No. 5, 188 proof, dr., gal.	.39 - ----	.42 - ----	.50 - ----
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.05 - .05½	.05¼- .05½	.05½- .06
Potash, lump, bbl., lb.	.03½- .04	.03 - .03½	.02½- .03½
Aluminum sulphate, com., bags, cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	2.00 - 2.10
Aqua ammonia, 26°, drums., lb.	.03 - .04	.03 - .04	.03 - .04
tanks, lb.	.02½- .02¾	----	----
Ammonia, anhydrous, cyl., lb.	.15½- ----	.15 - ----	.14 - ----
tanks, lb.	.05½- ----	----	----
Ammonium carbonate, powd. tech., casks, lb.	.10½- .11	.10½- .11	.12 - .13
Sulphate, wks., cwt.	1.70 - ----	1.85 - ----	2.20 - ----
Amylacetate tech., tanks, lb., gal.	.222- ----	2.22 - ----	----
Antimony Oxide, bbl., lb.	.08½- .10	.08½- .10	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	58 00 -60.00	58 00 -60 00	57.50 -60 00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	64 00 -70.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.08 - .08½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.04 - .04½
Bleaching powder, f.o.b., wks, drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.033- .033	.033- .033	.02½- .03
Bromine, cs., lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags	3.00 - ----	3.00 - ----	4.50 - ----
Arsenate, dr., lb	.07 - .08	.07 - .10	.06½- .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	20 00 - ----	20 00 - ----	20 00 - ----
flake, dr., wks., ton.	22.75 - ----	22.75 - ----	22.75 - ----
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums, lb.	.05½- .06	.05½- .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.024- ----	.024- ----	.03 - ----
Cylinders	.04 - .06	.04 - .06	.05 - .08
Cobalt oxide, cans, lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton	13.00 -14.00	13.00 -14.00	16 00 -17.00
Copper carbonate, bbl., lb.	.09 - .18	.10 - .18	.19 - .21
Cyanide, tech., bbl., lb.	.45 - .46	.49 - .50	.49 - .50
Sulphate, bbl., cwt.	4.25 - 4.50	4.75 - 5.00	6.00 - 6.10
Cream of tartar, bbl., lb.	.26 - .27	.26½- .27	.27½- .28
Diethylene glycol, dr., lb.	.11 - .13	.11 - .13	.10 - .15
Epsom salt, dom., tech., bbl., cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.103- ----	.106- ----	.125- ----
Formaldehyde, 40%, bbl., lb.	.07½- .08	.07½- .08	.08½- .09
Furfural, dr., contract, lb.	.10 - .12	.10 - .12	.15 - .17
Fusel oil, crude, drums, gal.	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr., gal.	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Galubers salt, bags, cwt.	1.11 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.13 - .13½	.13 - .13½	.14 - .15
Lead:			
White, basic carbonate, dry casks, lb.	.07½- ----	.07½- ----	.09 - ----
White, basic sulphate, sck., lb.	.07½- ----	.07½- ----	.08½- ----
Red, dry, sck., lb.	.09 - ----	.08½- ----	.10 - ----
Lead acetate, white crys., bbl., lb.	.12 - .13	.13 - .14	.13 - .13½
Lead arsenate, powd., bbl., lb.	.13 - .14	.13 - .14	.12 - .13
Lime, chem., bulk, ton	8.50 - ----	8.50 - ----	8.50 - ----
Litharge, pwd., csk, lb.	.08 - ----	.07½- ----	.09½- ----
Lithopone, bags, lb.	.05½- .06	.05½- .06	.05½- .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06½- .07
Methanol, 95%, tanks, gal.	.38 - ----	.38 - ----	.55 - ----
97%, tanks, gal.	.39 - ----	.39 - ----	.55 - ----
Synthetic, tanks, gal.	.40½- .45	.40½- ----	----
anti-freeze, 76½%, tanks, gal.	.31	----	----
Nickel salt, double, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Single, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb	.11 - ----	.11 - ----	.12½- ----
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.55 - .57
Yellow, cases, lb.	.31 - .32	.31 - .32	.32 - .33
Potassium bichromate, casks, lb.	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½- .06	.05½- .06	.05½- .06
Chlorate, powd., lb.	.08½- .09	.08½- .09	.07½- .08½
Cyanide, cs., lb.	.57½- .58	.52 - .55	.51 - .53
First sorts, csk., lb.	.08½- .09	.08½- .09	.08½- .09
Hydroxide (caustic potash) dr., lb	.06½- .06¾	.06½- .06¾	.07½- .07¾
Muriate, 80% bgs., ton	37.15 - ----	37.15 - ----	36.75 - ----
Nitrate, bbl., lb.	.06 - .06¼	.06 - .06¼	.06 - .07½
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.19 - .19½
Sal ammoniac, white, casks, lb	.046- .05	.046- .05	.047- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	18.00 -20 00	20.00 -22.00	16.00 -18.00
Soda ash, light, 58%, bags, contract, cwt.	1.32 - ----	1.32 - ----	1.32 - ----
Dense, bags, cwt.	1.35 - ----	1.35 - ----	1.35 - ----
Soda, caustic, 76%, solid, drums, contract, cwt.	2.90 - 3.00	2.90 - 3.00	2 90 - 3.00
Acetate, works, bbl., lb.	.04 - .05	.04 - .05	.05 - .05½
Bicarbonate, bbl., cwt.	2.00 - 2 25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	12.00 -15.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb.	.05½- .07½	.07½- .08	.06½- .06¾
Chloride, tech., ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.17 - .18	.18 - .22	.18 - .22
Fluoride, bbl., lb.	.08½- 09	.08½- .09½	.08½- .09
Hyposulphite, bbl., lb.	2 40 - 2 50	2 40 - 2.50	2.50 - 3.00
Nitrate, bags, cwt.	1 99 - ----	2 07 - ----	2.10 - ----
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.03 - .03½	.03 - .03½	.03½- .03¾
Prussiate, yel. drums, lb	.11½- 12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.75 - 1.15
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.03½- .04
Sulphite, cyrs., bbl., lb.	.03 - .03½	.03 - .03½	.02½- .03
Sulphur, crude at mine, bulk, ton	18 00 - ----	18.00 - ----	18.00 - ----
Chloride, dr., lb.	.05 - .06	.04 - .05	.04 - .05
Dioxide, cyl., lb.	.06½- .07	.07 - .08	.09 - .10
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom. - ----	nom. - ----	.14½- ----
Oxide, bbl., lb.	.36 - ----	36 - ----	.53 - ----
Crystals, bbl., lb.	.27½- ----	.27½- ----	.35½- ----
Zinc chloride, gran., bbl., lb.	.06½- .06¾	.06¾- .06¾	.06½- .06¾
Carbonate, bbl., lb.	.10¼- .11	.10¼- .11	.10 - .11
Cyanide, dr., lb.	.41 - .42	.40 - .41	.40 - .41
Dust, bbl., lb.	.07½- .08	.08 - .08½	.09 - .10
Zinc oxide, lead free, bag, lb.	.06½- ----	.06¾- ----	.06½- ----
5% lead sulphate, bags, lb.	.06½- ----	.06¾- ----	.06½- ----
Sulphate, bbl., cwt.	3 00 - 3 25	2 75 - 3.00	2 75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.11½-$0.12½	$0.11¾-$0.12½	$0.13½-$0.14
Chinawood oil, bbl., lb.	.09½- ----	.09 - ----	.14½- ----
Coconut oil, Ceylon, tanks, N.Y., lb.	.06½- ----	.06½- ----	.06¾- ----
Corn oil crude, tanks, (f.o.b. mill), lb.	.07½- ----	.06¾- ----	.07½- ----
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.07 - ----	.07½- ----	.07½- ----
Linseed oil, raw, car lots, bbl., lb.	.138- ----	.138- ----	.128- ----
Palm, Lagos, casks, lb.	.06 - ----	.06 - ----	.07½- ----
Niger, casks, lb.	.05½- ----	.05½- ----	.0 - ----
Palm Kernel, bbl., lb.	.06½- ----	.07 - ----	.08½- ----
Peanut oil, crude, tanks (mill), lb	.07½- ----	.07½- ----	.08½- ----
Rapeseed oil, refined, bbl., gal.	.58 - .60	.58 - .60	.82 - .84
Soya bean, tank (f.o.b. Coast), lb.	.08½- ----	.08½- ----	.09½- ----
Sulphur (olive foots), bbl., lb.	.07½- ----	.07½- ----	.09 - ----
Cod, Newfoundland, bbl., gal.	.53 - .55	.55 - .57	.65 - .67
Menhaden, light pressed, bbl., gal.	.47 - .49	.54 - .56	.70 - .72
Crude, tanks (f.o.b. factory), gal.	.27½- ----	nom. - ----	.43 - ----
Whale, crude, tanks, gal.	.78 - ----	.78 - ----	.79 - .80
Grease, yellow, loose, lb.	.04½- ----	.04½- ----	.06½- ----
Oleo stearine, lb.	.08½- ----	.08½- ----	.09½- ----
Red oil, distilled, d.p. bbl., lb.	.09 - ----	.09 - ----	.09½- .09¾
Tallow, extra, loose, lb.	.05½- ----	.05½- ----	.08¾- ----

Coal Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0 60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra, lb.	.15 - .15½	.15 - .15½	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums, lb.	.60 - .65	.60 - .65	.60 - .65

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.70 - .72
Benzoic acid, U.S.P., kgs, lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech., dr., lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal.	.21 - .23	.21 - .23	.22 - .23
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks., gal.	.60 - .70	.60 - .70	.73 - .75
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoleun, bbl., lb.	.16 - .17	.16 - .17	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb.	.39 - .40	.39 - .40	.45 - .47
H-acid, bbl., lb.	.68 - .70	.68 - .70	.63 - .65
Naphthalene, flake, bbl., lb.	.04½- .05	.04½- .05	.05 - .06
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.52 - .53
Para-nitrotoluine, bbl., lb.	.29 - .30	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb.	.14½- .15	.14½- .15	.15 - .17
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.50 - 1.80	1.75 - 1.90	1.35 - 1.50
R-salt, bbl., lb.	.44 - .45	.44 - .45	.47 - .49
Resorcinal, tech., kegs, lb.	1.15 - 1.25	1.15 - 1.25	1.30 - 1.40
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.30 - .32
Solvent naphtha, w.w., tanks, gal	.28 - .30	.28 -	.35 -
Tolidine, bbl., lb.	.91 - .93	.91 - .93	.95 - .96
Toluene, tanks, works, gal.	.35 -	.35 -	.35 -
Xylene, com., tanks, gal.	.25 - 28	.25 - .28	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	.13½- .16	.13½- .15	.15½- .16
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	10.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.05 - .22	.05 - .22	.06½- .07
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.31 - .32
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.03 - .35
Chrome green, bbl., lb.	.27 - .28	.27 - 28	.27 - .30
Carmine red, tins, lb.	6.00 - 6 50	6.00 - 6 50	5.25 - 5.50
Para toner, lb.	.77 - .80	.77 - 80	.70 - .80
Vermilion, English, bbl., lb.	1.90 - 2.00	1.90 - 2 00	1.80 - 1.85
Chrome yellow, C. P., bbl., lb.	.17 - .17½	.17 - .17½	.15½- .16
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	5.75 - 7.00
Graphite, Ceylon, lump, bbl., lb.	.04 - .05	.04 - .05	.08 - .09
Cum copal Congo, bags, lb.	.07 - .09	.07 - .08	.07½- .08
Manila, bags, lb.	.16 - .17	.16 - .17	.15 - 18
Damar, Batavia, cases, lb.	.16 - .16½	.16 - .19	.22 - .23
Kauri No. 1 cases, lb.	.48 - .50	.48 - 53	.48 - 53
Kieselguhr (f.o.b. N. Y.), lb.	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	40.00 -	40.00 -	40.00 -
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	5.25 -	5.85 -	8.50 -
Turpentine, gal.	.40 -	.43 -	.51 -
Shellac, orange, fine, bags, lb.	.50 - .52	.50 - .52	.61 - .62
Bleached, bonedry, bags, lb.	.36 - .37	.36 - .37	.56 - .60
T. N. bags, lb.	.27 - .28	.27 - .28	.46 - .47
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10 00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	9.50 -	9.50 -	10.50 -
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -	13.75 -	13.75 -

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.22 -$0.24	$0.22 -$0.24	$0.28 -$0.30
Beeswax, ref., light, lb.	.35 - .36	.35 - .36	.41 - .42
Candelilla, bags, lb.	.18 - .20	.18 - .20	.23 - .24
Carnauba, No. 1, bags, lb.	.28 - .29	.28 - .29	.50 - .51
Paraffine, crude 105-110 m.p., lb.	.04 - .04½	.04½- .05	.04½- .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200 00-	$200.00-	$200.00-
Ferromanganese, 78-82%, ton	94 00-99.00	94.00-99.00	105.00-
Spiegeleisen, 19-21%, ton	34.00-	33.00-	32.00-
Ferrosilicon, 14-17%, ton	39.00-	45.00-	45.00-
Ferrotungsten, 70-80%, lb.	1.20	1.45-	1.35-
Ferro-uranium, 35-50%, lb.	4.50 -	4.50-	4.50-
Ferrovanadium, 30-40%, lb.	3.15- 3.50	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.10775	$0 11½ -	$0.18½ -
Aluminum, 96-99%, lb.	.233	.233	.24 - .25
Antimony, Chin. and Jap., lb.	.08 - .08½	.06½-	.09½ -
Nickel, 99%, lb.	.35 -	.35 -	.35 -
Monel metal, blocks, lb.	.28 -	.28 -	.28 -
Tin, 5-ton lots, Straits, lb.	.301-	.29½-	.45½ -
Lead, New York, spot, lb.	.055-	.052	.07 -
Zinc, New York, spot, lb.	.048-	.0447	.07 -
Silver, commercial, oz.	.34½-	.42½-	.52½ -
Cadmium, lb.	.70 - .75	.70 - .75	.85 - .95
Bismuth, ton lots, lb.	1.00 -	1.28 -	1 70 -
Cobalt, lb.	2.50 -	2.10 - 2.50	2 50 -
Magnesium, ingots, 99%, lb.	.85 - 1.10	.85 - 1.10	85 - 1.10
Platinum, ref., oz.	43 00- 45.00	43 00- 45.00	70.00 70.00
Palladium ref., oz.	23.00- 24.00	30.00- 35.00	42.00-46.00
Mercury, flask, 75 lb.	116.00-	117.00-	123.00-
Tungsten powder, lb.	1 70- 1.75	1.35- 1.50	1.10- 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$7.50- $8.00	$7.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post, ton	21.50- 25 00	21.50- 25.00	22.00- 23.00
Coke, fdry., f.o.b. ovens, ton	2.75- 2 85	2.75- 3.85	2.85- 3.00
Fluorspar, gravel, f.o.b. Ill., ton	18.00- 20.00	18.00- 20.00	17.00- 18.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.31 - .36	.31 - .36	.36 - .38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.48 - .50	48 - .50	.48- .50
Monazite, 6% of ThO_2, ton	60.00-	60.00-	130.00-
Pyrites, Span. fines, c.i.f., unit	.13 -	.13 -	.13 -
Rutile, 94-96% TiO_2, lb.	.10 - .11	.10 - .11	.11 - .13
Tungsten, scheelite, 60% WO_3 and over, unit	15.25- 16.50	15 25 -16.50	11.25 -11 50
Zircon, 99%, lb.	.03 -	.03 -	.03 -

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

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Aluminum Parts Factory—Bohn Aluminum & Brass Co., Jos Campau Ave., Detroit, Mich., is having plans prepared for a 1 story, 40 x 300 ft. aluminum parts factory. Estimated cost $50,000. C. W. Brandt, 1109 Francis Palms Bldg., Detroit, is architect.

Tinallium Products—Tinallium Products Co., c/o A. Tinally, Pres., Builders Exchange Bldg., San Antonio, Tex., plans the construction of service stations at San Antonio, Dallas, Houston, Amarillo, El Paso, etc. for marketing the new tinallium products. Kelwood Co., 703 Travis Bldg., San Antonio, is architect. Equipment will be purchased.

Factory—Bakelite Corp., 247 Park Ave., New York, N. Y., awarded contract for the construction of a 1, 2 and 3 story, 405 x 410 ft. manufacturing building to include machine shop, garage, power house, storage building, etc., at River Rd., Bound Brook, N. J., to Karno-Smith Co., Inc., Broad St. Bank Bldg., Trenton. Estimated cost $150.000.

Brass Plant Additions — Anaconda American Brass Ltd., New Toronto, Ont., will build two 1 story, 70 x 450 and 98 x 100 ft. additions to plant. Estimated cost $200,000. Work will be done by day labor.

Brass Foundry — Republic Brass Co., 1623 East 45th St., Cleveland, O., awarded contract for a 1 and 2 story, 25 x 136 ft. addition to foundry to A. A. Lane Construction Co., 1873 East 55th St., Cleveland, O. Estimated cost $40,000.

Iron Foundry—Brooklyn Brass Works, 263 Scholes St., Brooklyn, N. Y., will soon award contract for the construction of a 2 story iron foundry. Estimated cost $40,000. Lee & Hewitt, 152 Market St., Paterson, N. J., are architects.

Iron and Bronze Factory—W. S. Tyler Co., 3613 Superior Ave., Cleveland, O., (ornamental iron & bronze) awarded contract for a 3 story, 70 x 106 ft. factory at East 36th St. and Superior Ave. to Aronberg-Fried Co., Terminal Tower, Cleveland. Estimated cost $100,000.

Carbon Black Plant—Oklahoma Carbon Mfg. Co., Sayre, Okla., will build a carbon black plant. Estimated cost $30.000. F. L. Coogan, Sayre, is engineer.

Cement Packing Plant — Marquette Cement Manufacturing Co., R. W. Meyer, Local Mgr., 1623 Arcade Bldg., St. Louis, Mo., awarded contract for alterations and additions to cement packing plant, to include five silos for storing cement, etc., to A. D. Gates Construction Co., 1611 Chemical Bldg., St. Louis. Estimated cost $50,000.

Chemical and Pigments Factory—Chemical and Pigments Corp., St. Helena, Md., awarded contract for two 1 and 2 story, 50 x 110 ft. factory buildings to Price Construction Co., Maryland Trust Bldg., Baltimore.

Chemical Refinery Building—Forest Products Chemical Co., W. H. Matthews, Pres., Peres St., Memphis, Tenn., will soon start work on remodeling of and addition to refinery building for production of chemicals, charcoal, etc., from wood products. J. Hunter, Union and Planters Bldg., Memphis, is engineer.

Chemical Plants — Merrimac Chemical Co., Inc., 148 State St., Boston, Mass., awarded contract for a sulphuric acid plant, to Aberthaw Construction Co., 80 Federal St., Boston. $50,000; muriatic acid building, to P. J. MacNaughton Co., Inc., 711 Boylston St., Boston, also taking bids for a 1 and 2 story, 50 x 170 ft. chemical plant at Everett.

Chemical Plant—Drumchrome Corp., c/o W. L. Finne, 1201 East Grand St., Elizabeth, N. J., Archt., is having plans prepared for a 1 and 2 story factory at Rahway. Estimated cost $40,000.

Chemical Factory — McKesson & Robbins, Fairfield, Conn., awarded contract for a factory for the manufacture of household chemicals, drugs, etc., to T. J. Pardy Construction Co., 1481 Seaview Ave., Bridgeport. Estimated cost $50,000.

Chemical Plant — Wallace & Tierman Co. Inc., 11 Mill St., Belleville, N. J., awarded contract for a 4 story, 78 x 170 ft. addition to factory for the manufacture of chlorine apparatus at Schuyler Ave. and Terrace Pl., to Mahoney Troast Co., 657 Main Ave., Passaic. Estimated cost $150,000.

Concentration Plant—John, George & Frank Bingham, Wardner, Idaho, plan the construction of a 150 ton concentration plant.

Copper Reduction Mill—Consolidated Copper Co., J. F. Reddy, Pres., Medford, Ore., had plans made for a copper reduction mill.

Flotation Mill and Crusher—Mutual Mines Development Co., Wallace, Idaho, R. F. Collins, Dir., Coeur d'Alene, will build a 100 ton flotation mill and 300 ton crusher at Wallace. Work will be done by day labor.

Galvanizing Plant — Westinghouse Electric & Mfg. Co., W. H. Freiner, Const. Mgr., West 54th St., Cleveland, O., awarded contract for a 1 story, 60 x 80 ft. galvanizing plant, to A. A. Lane Construction Co., 1873 East 55th St., Cleveland. Estimated cost $40,000.

Explosives Plant — Hercules Powder Co., Wilmington, Del., plans rearrangement of plant facilities at Carthage, Mo., to include nine new buildings. Estimated cost $175,000. Work will be done by owner's forces under the supervision of J. S. Marks, Carthage, Plant Supt., and R. K. Hallett, Wilmington, Del., Const. Engr.

Gas Compressor Station—Cities Service Gas Co., Bartlesville, Okla., is having plans prepared for the construction of a natural gas compressor station, 2,000 hp. near Higgins, Tex. Estimated cost $90,000. Private plans.

Gas Plant—City of Guelph, Ont., plans the construction of a coal gas retort, vertical type in connection with gas plant. Estimated cost $150,000. N. S. Nicklin, City Hall, is engineer.

Gas Plant—Commercial Gas Co. Ltd., c/o T. F. Langston, Pres., Los Angeles, Calif., plans the construction of a gas plant using Butane system of liquified petroleum at Kingman, Ariz. Estimated cost $50,000.

Gas and Electric Distribution Plant—City of Norwich, Conn., awarded contract for a gas and electric distribution plant on North Main St., to P. F. Sweeney, 25 Chestnut St., Norwich. Estimated cost $40,000.

Glass Factory—Capstan Glass Co., Connellsville, Pa., awarded contract for the design and construction of a 1 story, 116 x 200 ft. warehouse building, in connection with factory, to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $200,000.

Chemistry Building—Bd. of Trustees, Miami University, Oxford, O., c/o A. T. Connan, Dir. Dept. of Public Works, Columbus, will soon award contract for a 3 story, 98 x 104 ft. chemistry building at Oxford. Estimated cost $200,000. Garber & Woodward, 4 West 7th St., Cincinnati, O., are architects.

Laboratory—Bd. of Regents, University of Texas, J. W. Calhoun, Comptroller, Austin, Tex., is having plans prepared for the construction of a 3 story laboratory at Galveston. Estimated cost $350,000. H. Greene, La Roche & Dahl, 307 Construction Bldg., Dallas, are architects.

Laboratory—Hughes Development Co., 1001 North Orange Dr., Los Angeles, Calif., awarded contract for a 2 story, 150 x 295 ft. laboratory to Meyers Bros., 3407 San Fernando Rd., Los Angeles. Estimated cost $200,000. Multicolors Ltd., N. Dietrich, Pres., c/o owner, is lessee.

Laboratory — Truhek Laboratories, East Rutherford, N. J., will soon award contract for a 1 story, 45 x 160 ft. laboratory. Estimated cost $40,000. Private plans.

Laboratory and Mill—Spang Chalfant & Co., Clark Bldg., Pittsburgh, Pa., awarded contract for a 2 story, 40 x 90 ft. laboratory on Duss Ave., to Cuthbert Bros. Co., Bessemer Bldg., Pittsburgh, $150,000. Also plans a mill for making pipe by new electric weld process. $2,000,000.

Laboratory (Chemical)—Calco Chemical Co., Bound Brook Rd., Bound Brook, N. J., will soon award contract for a 4 story, 40 x 105 ft. chemical laboratory and office. Estimated cost $40,000. F. G. Joannes, 420 Lexington Ave., New York, N. Y., is architect.

Laboratories (Chemistry and Physics)—Fisk University, Nashville, Tenn., is having plans prepared for chemistry and physics laboratories. Estimated cost $200,000. H. H. Hibbs, Nashville, is architect.

Laboratory (Drug) and Warehouse—Brunswig Drug Co., 501 North Main St., Los Angeles, Calif., plans a 5 story, 150 x 250 ft. laboratory and warehouse at Second and San Pedro Sts. Estimated cost $750,000. Architect not selected.

Laboratory (Pathological)—Dept. of Hospitals, Municipal Bldg., New York, N. Y., received lowest bid for the construction of a pathological laboratory at Sea View Hospital, Richmond, N. Y., from Henney Contracting Co., 2 Lafayette St., New York, $38,500.

Laboratory (Physics) — Harvard University, Cambridge, Mass., awarded contract for a 3 story physics laboratory to Turner Construction Co., 178 Tremont St., Boston. Estimated cost $500,000.

Laboratory (Science) — Grove City College, Grove City, Pa., is having plans prepared for a 2 story, 100 x 300 ft. science laboratory. Estimated cost $300,000. W. G. Eckles & Co., Lawyers Savings & Trust Co., New Castle, are architects.

Laboratories (Science) — Pasadena College, North Bresse St., Pasadena, Calif., is having preliminary plans prepared for the construction of a group of college buildings including science laboratories, etc. at 1539 Howard St. Estimated cost $500,000. Marsh, Smith & Powell, 1516 Architects Bldg., Los Angeles, are architects. Work will be done by day labor.

Laboratory (Steel) — Midvale Co., 4300 Wessahickon Ave., Philadelphia, Pa., awarded contract for a 2 story, 50 x 100 ft. laboratory and office at Roberts Ave. and Blabon St., to Barclay White Co., 22 North 36th St., Philadelphia.

Laboratories—Bd. of Education, Gary, Ind., will soon readvertise for bids for the construction of a 3 story high school including laboratories, etc., at 46th and Madison Sts., Gary. Estimated cost $1,000,000. W. B. Ittner, Inc., Continental Life Bldg., St. Louis, Mo., are architects.

Paint Manufacturing Plant—Benjamin Moore & Co., Carteret, N. J., will soon award contract for the construction of a 2 story paint manufacturing plant. Estimated cost $40,000. Poggi & Bragdon, 275 Morris Ave., Elizabeth, are architects.

Paint Manufacturing Plant—Lowe Bros. Co., 335 Grand St., Jersey City, N. J., plans to rebuild 2 story paint manufacturing plant at Grand St. and Jersey Ave. Estimated cost $50,000. Architect not selected.

Paper Plant — Adams Paper Co., Baldwinville, Mass., plans the construction of a paper plant. Estimated cost $50,000. Private plans.

Paper Plant—Hammermill Paper Co., E. R. Bahrend, Pres., East Lake Rd., Erie, Pa., awarded contract for a 1 story, 20 x 90 ft. finishing room in connection with plant, to H. Platt Co., 1006 Palace Hardware Bldg. Estimated cost $62,000.

Paper Mill—St. Regis Paper Co., Tacoma, Wash., R. B. Maltby, 60 East 42nd St., New York, N. Y., V. Pres., acquired the plant of Union Bag & Paper Co. at Tacoma, and plans the construction of a large mill to double capacity. Estimated cost $2,000,000.

Paper Plant — Strathmore Paper Co., Mittineague, Mass., had plans prepared for the construction of a paper plant at West Springfield. Estimated cost $125,000. L. R. Howe, c/o owner, is architect.

Wallpaper Manufacturing Plant — Becker Smith & Page, Water and Snyder Sts., Philadelphia, Pa., awarded contract for a 2 and 3 story, 117 x 305 ft. wall paper manufacturing plant to Wark Co., 1608 Walnut St., Philadelphia.

Pulp Mill—Wyerehauser Timber Co., A. L. Raught, Mgr., Longview, Wash., will soon start work on a 150 ton sulphite pulp mill.

Pottery Plant—Cronin China Co., New Cumberland, W. Va., manufacturers of potteryware, plans the construction of a 1 story addition to plant, also bisque and glass kiln. Estimated cost $40,000. Private plans.

Storage Tanks—Archer-Daniels-Midland Co., 29th Ave., Minneapolis, Minn., manufacturers of linseed oil, plans the construction of flax storage tanks at Connor's Point, Superior, Wis.

Benzol Plant and Coke Storage and Scale House—New England Fuel & Transportation Co., 250 Stuart St., Boston, Mass., awarded contract for the construction of a benzol plant to Koppers Construction Co., Koppers Bldg., Pittsburgh, Pa., also coke storage building and scale house to include six silos, 90 ft. on Centre St., Quincy, Mass. to Rust Engineering Co., Koppers Bldg., Pittsburgh, Pa.

Gasoline Plant—Westoak Gasoline Co., Sayre, Okla., will build a casinghead gasoline plant. Estimated cost $75,000. F. L. Coogan, is engineer.

Insecticide Manufacturing Plant — Standard Oil Co. of New Jersey, Brunswick Ave., Linden, N. J., awarded contract for a 2 story, 125 x 185 ft. insecticide manufacturing plant, to The Austin Co., 120 Broadway, New York, N. Y. Estimated cost $200,000.

Oil Distribution and Automotive Building — Vacuum Oil Co., 61 Broadway, New York, N. Y., awarded contract for a 1 story, 75 x 215 and 50 x 120 ft. oil distribution and automotive building, also 1 and 2 story, 40 x 70 ft. laboratory at Paulsboro, N. J., to Turner Construction Co., 420 Lexington Ave., New York, N. Y. Estimated cost $75,000 and $40,000 respectively.

Refinery — Roy Westbrook & Associates, Thrall and Ft. Worth, Tex., plan the construction of a 3,000 bbl. refinery to consist of skimming unit and special process for extracting fuel oil from crude. Estimated cost $125,000. Private plans.

Refinery (Oil) — Altitude Petroleum Co., Perine Bldg., Oklahoma City, Okla., will build a 2,000 bbl. oil refinery. Estimated cost $250,000. Private plans.

Refinery (Oil)—Chalmette Petroleum Corp., W. E. Winship, Pres., New Orleans, La., plans to rebuild oil refinery to include laboratory, warehouse, etc., recently destroyed by fire. $30,000.

Refinery (Oil)—Cosden Oil Co., Fort Electric Bldg., Fort Worth, Tex., plans the construction of an oil refinery at Tidewater. Estimated cost $300,000. Private plans.

Rubber Factory — Ohio Rubber Co., Willoughby, O., awarded contract for the construction of a 1 story, 120 x 480 ft. factory for the manufacture of rubber goods and specialties, to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $100,000. Equipment to cost $500,000 will be required.

Steel Rolling Mill Addition—Otis Steel Co., E. J. Kulas, Pres., 3341 Jennings Rd., Cleveland, O., is having preliminary plans prepared for a 1 story addition to steel rolling mill. Estimated cost $5,000,000. Private plans.

INDUSTRIAL NOTES

INTERNATIONAL FILTER COMPANY has moved its general offices to 59 East Van Buren St., Chicago, where its engineering department will also be situated.

GENERAL REFRACTORIES COMPANY has opened a new sales office in the Empire Building, Birmingham, Ala., under Walter S. Stapeler.

COATESVILLE BOILER WORKS, Coatesville, Pa., have acquired the Middletown (Pa.) plant of the Standard Steel Car Company.

FOXBORO COMPANY, Foxboro, Mass., has appointed G. B. Lane manager at the Tulsa (Okla.) office to replace J. B. McMahon, who has taken charge of field engineering service at the home office.

E. D. BULLARD COMPANY has established a Chicago office at 224 West Huron St., in charge of G. M. Glidden.

TOOLE ENGINEERING & MACHINE COMPANY, Baltimore, has appointed Neil Otey manager of the Pittsburgh office at 245 Union Trust Building.

JOHN H. BARKER, representing the LaBour Company, has moved his office to 154 Nassau St., New York.

FERRO ENAMEL CORPORATION, Cleveland, Ohio, is the name given to the consolidation of the Ferro Enameling Company and the Ferro Enamel Supply Company, which were originally formed as affiliated companies.

DESPATCH OVEN COMPANY, Minneapolis, has reorganized its Chicago office under W. F. Appleton and J. H. Hopp.

LEAVITT MACHINE COMPANY, Orange, Mass., has appointed Charles C. Phelps as agent at 11 Park Place, New York.

CUTLER-HAMMER, INC., Milwaukee, Wis., has acquired the Reynolite Division of the Reynolds Spring Company, Jackson, Mich.

CHICAGO BRIDGE & IRON WORKS has opened a new office in Tulsa, Okla., in charge of D. A. Leach.

LINK-BELT COMPANY, Chicago, has installed its Pacific Division in a new office and manufacturing plant at San Francisco, Calif.

QUIGLEY COMPANY, INC., is the changed title adopted by the Quigley Furnace Specialties Company, Inc., New York, because of its expanded range of products.

BARETT-CRAVENS COMPANY, Chicago, has moved into its new plant at 101 West 87th St., and is now under the same roof as its two affiliated companies, the Walker Electric Company and the Automatic Transportation Company.

BABCOCK & WILCOX COMPANY will now have its refractory cement and plastics distributed in Chicago by Meyer & Oswald, Inc., 332 South La Salle St.